A CHILDREN’S HOSPICE

MSC04 - ARK GROUP 30, JUNE 2016

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ABSTRACT

This report describes a fictional project about the design of a children's hospice located in Perbermosen in Hammer Bakker, Northern Jutland.

The design is developed through the use the integrated design process, which through a holistic approach combined with a series of iterative tests, aims to create a fully integrated design for the future design of a children's hospice.

Focus lies on creating a health care facility that offers professional palliative care, while facilitating a place for patients and relatives to spend their last time together in a dignifying and comfortable manner.

The rapport addresses design and function through sustainability, neuro aesthetic design parameters, interview with chief of development at Sankt Lukas children's hospice,Signe Hørlück, and established scientific studies within the field of children's design, healing and palliative architecture.

The process following the design parameters chosen in the programs leads into the design of a children's hospice that upholds the requirement needed for it to provide palliative care and sustain the daily routines in the afflicted families. The building upholds the requirements for a zero energy building and constructions standards.

THEME:

A Children's Hospice

INSTITUTE:

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SUPERVISORS:

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PROJECT PERIOD: Feb 2016 - June 2016

PAGES: 137

PROJECT GROUP

GROUP 30

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PREFACE

The 4.th semester thesis of the specialization program in Architectural design focuses on the integrated design process in the development of a hospice for children and youths. Technical, spatial, social, functional, logistical and aesthetic problems is solved within an integrated design approach.

SPECIAL THANKS TO:

Signe Hørlück from Sankt Lukas Huset

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Peter Vilhelm Nielsen

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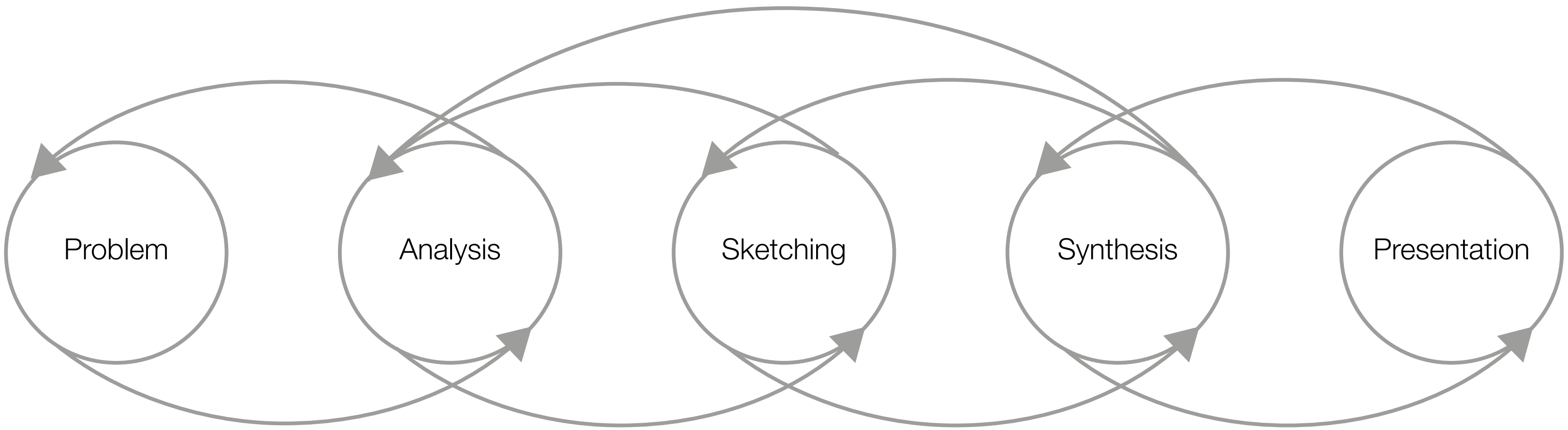
INTRODUCTION

This project strives to design a hospice for children and youths in the age spanning from 0-18 years old. The mantra for the project goes; “The dying are still living”. Aiming for the creation of a space that offers a worthy final destination for a human in the terminal stage of life, while accommodating the needs of the relatives and staff.
Located near the beautiful scenery at Pebermosen in Hammer bakker, this hospice design relies on theory from healing architecture, palliative care and neuro aesthetics and sustainable solutions, as design parameters for the development of a modern and integrated care facility that fulfill the building regulation’s 2020 energy demands.



ill. 001: Diagram showing the relation between each phase of the integrated design process (Knudstrup, 2005)

METHOD

This thesis project is developed using the integrated design process. The design process seeks to implement design specialisms, that usually are handled separately, earlier in the architectural design phases, where technical parameters becomes a tool for designing.

The integrated design is divided into five different phases; The problem phase, analysis phase, sketching phase, synthesis phase and presentation phase. Each of these phases is intertwined meaning, phases must be developed using an iterative process. Where each result is compared and evaluated to existing parameters determined in earlier phases.

The problem phase determines initial framework for the given project with a description of the project idea.

The analysis phase encompasses all relevant information regarding the project. In this thesis the analysis phase consists of several theme analysis, contextual- and climate analysis, several case studies, demands for functionality and detailed information, the room programme which contribute with parameters which works both as catalysts in the form of guidelines but also as regulations.

The sketching phase is as the name suggest the phase where knowledge of the architectural and engineering field is being processed into several designs, which is developed towards fulfilling the demands listed in the analysis phase. Each design is consistently evaluated and compared to the analysis phase. The phase is described through sketches and diagrams that illustrates the overall concepts, ideas and preliminary solutions.

The synthesis phase is the phase where a chosen design that fulfills the parameters of the analysis phase, starts taking its final form. All the demands and requirements are met and the design is adapted accordingly, creating a synergy between the design and parameters. In this phase every detail is being optimized and more qualities can be added.

The presentation phase is the final phase that presents the project through visualizations, drawings, diagrams and other illustrations, that expresses the goals of the project and how these goals are reached. (Knudstrup, 2005)

PROGRAM

Ill. 002: Image of Pebermosen during may

ill. 003: Image of Lukas Stiftelsen. (Sygeplejersken, 2012)

ill. 004: Patient in wheelchair. (Public domain, 2006)

HOSPICE

The hospice is, contrary to a hospital, not a place of healing and recovery, but a place of relief. This is the core of palliative care.
The hospice is a place where the ill and suffering can be relieved of pain and the stress of medical treatment.

Palliative care as a theoretical framework is a relatively recent concept, It was inspired by the English Dame Cicely Sanders and the first hospice opened in 1967 in London (Nissen et al., 2008). The first hospice in Denmark was Skt. Lukas Hospice, which opened in 1992 (Nissen et al., 2008) The idea is to give, dying and people suffering from chronic illness, a dignified and pleasant existence. The care patients receive at the hospice dampens their suffering. The care extends further than the afflicted. Relatives, who otherwise may have been suffering along with the patient, are likewise relieved of the stressful situation terminal or chronic illness may put them in. Hospices are in the public perceived as a place to die. However, this is only a half-truth. While hospices certainly facilitate life-ending procedures, there is great demand for patients with chronic illnesses that are not necessarily life threatening. These patients require specialized care and pain relief, but they are not permanent residents in the hospice. They will live there in critical periods of their illness but otherwise live at home, keeping a regular contact with the hospice.
When death is involved, the hospice is a place that attempts to remove the taboo that surrounds death in our culture. It is an integral part of existence and should be treated in a natural and dignified manner. A hospice should provide the relatives with closure and the dying with a state of calmness and dignity.

Patients in a hospice will have their own rooms, a rarity in a hospital, to give them peace and quiet. It is important that the patients feel at home in the hospice, since this greatly reduce the stress of the situation for the patient. Hospices will allow the patients to bring personal belongings and encourages a degree of customization in their rooms. The detailing in the room should be high and especially the ceilings are of great importance since the patients will spend most of their time lying down and looking up from their bed. Entertainment and communicative technologies should be readily available in the rooms, within the patient's field of view. In the hallways and common rooms, the hospice can facilitate a social sphere between patients and relatives or other patients. It is relieving for patients to know that they are not alone in their situation. Common rooms should create niches and spaces for meetings, but should also use niches and furniture to reduce the perceived space. Large open spaces can be intimidating to patients in palliative care and they will often feel small and lost in them.
It is important for the care to be almost invisible when not immediately needed, but readily available just outside the room. Having the personnel near but unseen, will make the patient feel safe. It liberates the patients from the intrusive feeling created by the constant supervision from medical professionals.
A hospice should also provide access to outdoors and green areas. Planned well, a sheltered outdoor garden can provide different impressions to the senses, this can be of great value to patients. For patients with a repressed immune system it can be a relief, since bacteria and vira can live for days indoors and the indoor environment requires constant cleaning.
The hospice is an institution, which takes care of the patients that are past life saving treatment. It provides them with a worthy existence and allows them to die with dignity or proceed with their life softening the symptoms of their illness. It provides the relatives with closure and relief, allowing them to carry on their lives without the trauma and stress the disease and death of a loved one can inflict.
It is a relatively new type of building and palliative care is still expanding as a field. Still there are plenty of experiences to draw from and great interest

ill. 005: Mother and child (Beattie, 2016)

ill. 006: Nurse and patient (Chestnutlottery, 2016)

in the field. This may spring from the fact that hospices have proven to be a necessary and valuable institution in the modern western society, and the demand far exceeds the number of beds the existing hospices provide. (Nissen et al., 2008)

ill. 007: Laughing child (Oxford House in Bethnal Green, 2015)

ill. 008: Image of the Hallway, Lukas Huset.

ill. 009: Common room, Lukas Huset.

ill. 010: Therapy room, Lukas Huset.

INTERVIEW WITH SIGNE HØRLÜCK, DEVELOPMENT OFFICER, FROM SANKT LUKAS CHILDREN AND YOUTH HOSPICE.

ABOUT THE SANKT LUKAS FOUNDATION:

It is a "diakonisse" foundation with around 30 sisters at this point. They live on donations. At this moment, the foundation runs the largest hospice in Denmark.

Sankt Lukas runs the only children and youth hospice in Denmark. While Children hospices have existed since the eighties in England, the concept is completely new in Denmark.
The facility is meant for testing, and is placed in an old building that is far from optimal. The test have to show how children's hospice work and which functions are needed.
Preliminary decisions has been made on a full functioning children's hospice. While there are no ongoing competition, there are sketches for a program as it is.

The temporary location has four patient units, and with an expected occupancy of 75%, can facilitate three families. Currently the age of the patients span from below 1 year to 18 years, while the majority of the patients is expected in the age of 4 to 11 years. The patients are rarely cancer patients, since hospitals treat them with priority. Most patients suffer from rare neurological diseases from child birth.The hospice currently employs 20 people with a varying number of volunteers.

THE CURRENT FACILITY

A major difference between adult- and children's hospices are the patient units. The existing units needs to be larger to facilitate families. In the current children hospice, the individual units can merge to houses larger families or divorced families. Many of the families who seek the hospice have had negative experiences with hospitals. Most relatives are not ethnically Danish. Even if the relatives did not share primary language, there were still plenty of interaction among them.
The most important element to help relatives are support and network at home, especially for relatives of children with immune deficiencies. Letting the child stay for periods in the hospice can help the families social life at home.

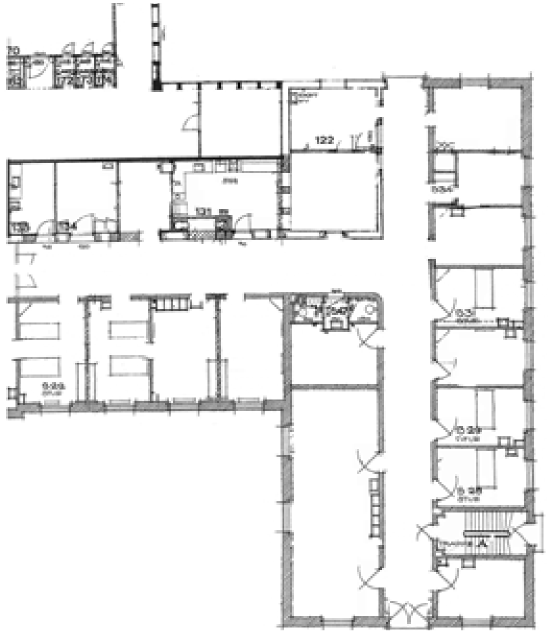
The department have a central kitchen that cooks for the existing hospice, but this is traditional danish food. Most relatives do not find this food appealing and prefer to cook themselves. It was discussed whether or not it would be favorable to place kitchenettes in the patient units, and the conclusion was that larger public kitchen would be preferable. Forcing the relatives out of the patient units provided psychological relief that they would not choose if they were able to cook in the units.

In the hospice, it is important to create an atmosphere of comfort and homeliness. Since most of the children suffer from a repressed immune system, it is important that the hospice is relatively sterile. This can come into conflict with the aesthetics, and the atmosphere may have to suffer to keep an adequate level of sterility. While there are no private bathrooms in the current building, this is an absolute must in the new. When the bathrooms are public, there is a clear breach in the privacy.
All rooms in the patient units open into the hallways for maximum accessibility. This way the child can receive treatments without disturbing the family.

Staff is visible but not invasive. While terminal patients in hospitals will be under 24 hour observation, this is not the case in a hospice. The children have the ability to call staff from the rooms. It is important that the families feel help is accessible at all times. The staff room and canteen is placed isolated. This is to keep the staff, that are not on watch, from being disturbed by patients and relatives.
Working in a children's hospice is taxing, and all members of staff are allowed to take breaks if they are not immediately needed. The staff has a permanent psychologist. The psychologist gives supervision and guidance in groups every second month. If necessary staff members can receive individual psychological treatment.
Life-ending procedures are calculated to two weeks. Other treatments can

ill. 011: Patient room Lukas Huset.

ill. 012: Family room, Lukas Huset.



ill. 013: Existing plan, Lukas Huset.

be relief procedures that take place mostly at home under guidance from the hospice, where frequent stays at the hospice can eb used to unburden relatives. The experience at the hospice have been, that life-ending procedures can take from 6 hours to longer than four months.

The personnel work in three shifts, physiotherapist and ergotherapist and doctors are available in the daytime. An emergency doctor is not needed due to the fact that most patients within a hospice should not be revived. If emergencies arise the staff on duty calls 112.
It is important that the hospice facilitate space for full staff meetings, where different ethical topics and potential solutions are discussed. (Hørlück, S. 2016)

WISHES FOR THE FUTURE HOSPICE

It is important that the patient units still consist of two rooms with an additional bathroom. One units should be around 60 m^2 nett. The goal is around 10 patients simultaneously. All rooms should still be reachable from the hallway. The rooms should have view to nature, but should block passerby's from looking in.

There should be two common rooms; these should be more open than the existing. Furniture creates niches.

The Hospice should be able to facilitate emergency baptism and should have rooms for conversation and emergency use.

One basin room large enough for siblings to join the patient. This is to strengthen the siblings role in the palliative treatment.

In general it is important that the facilities are flexible, especially the patient units. If functions are not constantly needed in a room, it may be more suitable to have them mobile. This could be patient lifts or oxygen supply.

The rise of multi resistant bacteria might have to be considered in the design, for instance a patient unit isolated from the rest of the facility.

Staff should stay at a central position in the facility, to shorten distance.
Outdoor spaces are necessary. Patient units should ideally have private gardens.

Coffin transport should be designed in a worthy and dignifying manner. It is important the relatives of a recently deceased don't get the impression that they are shoved out the back.

The arrival to the hospice should be planned carefully as it represent the first impression of the hospice.

There should be more creative rooms and therapy rooms. The current hospice holds only a single therapy room that can be used by parents and children outside therapy hours.
(Hørlück, S. 2016)

ill. 014: The patient

ill. 015: The relatives

USER GROUP

Patients
The patients that will be referred to a children and youth hospice will have to fulfil certain criteria's. To be referred the patient must be within the age span of 0-18 years old and fall within certain categories established by (Chambers, 2009)

- Conditions where an early death is inevitable, but where the child can have undergone long periods of treatment in order to prolong life.

- Progressive conditions where there is no available treatment, except palliative treatment that can be given over a number of years.

- Irreversible, but not progressive illnesses that are complex but where there is no healing treatment. This group often has an excessive need for health professionals, since complications and an early death are expected. (Chambers, L., 2009)

- Patient who are being referred to the daycentre are in need of specialised palliative treatment, while still being well enough to be spend the majority of their time in their own home.

At the same time the daycentre functions as a guide and help centre for the often overburdened families.
It is very important that the patients is treated with dignity and not deprived of their agency which should be a determining factor throughout the design. Furthermore it is important to remember that a large portion of the patients are either bedridden or traveling by wheelchair, which creates certain demand for accessibility as well as ceiling design and other objects within the patients view aspect.

Relatives
Relatives visualizing the scenario of losing a close family member are in need of extra ordinary help and counseling in order to achieve the best possible outcome of a dismal situation. Relatives should have the option of accommodation, use of common areas and conversation rooms. The better conditions the relatives experience, the more likely they are to participate in helping the staff with the daily routines concerning the patient. Included in the category "relatives" are often healthy brothers and sisters. The final hospice design should therefore include places and items relevant for entertaining healthy kids as well.

ill. 016: The staff

Staff

The staff is roughly divided into four categories of caretakers, a palliative team, volunteers and management.
The caretakers consist of minimum one nurse per patient during normal work hours and in this case with a maximum capacity of 10 patients. During night time the amount of caretakers drops down to one nurse for every second patient.
The palliative team includes an occupational therapist, a physio therapist and a pediatrician. The palliative team is present in the time frame from 8.00. - 16.00, or if called in special occasions.
The children's hospice also facilitates a team of volunteers that help and support the patient during their stay.
The management section consist of a daily hospice leader, a chief nurse and a chief of development each occupying their separate offices.
A psychologist is also present at special occasions, with the primary role of treating the staff in group sessions on a monthly basis, and in individual sessions if the need occurs.

The hospice design need to facilitate a good working environment with offices, meeting room, dressing room, social areas, quiet and private zones, but in a discreet and subtle manner in order not to disturb the homely atmosphere of the hospice. (Hørlück, S. 2016)

ill. 017: King Solomon School, Israel. (Nissim, 2014)

ill. 018: Kita Josef-Felder-Strasse, by Hiendl Schineis Architekten (Matthäus, 2013)

DESIGNING FOR CHILDREN

The complexity of designing a hospice is by itself impressive. The complexity do not decrease when design has to accompany patients within the span of 0-18 years old. Therefore it is absolutely critical to understand the differences between how young children and teenagers perceive and interact with their surroundings.

An essential parameter for children is exploration. The sense of adventure is a key element for mental and physical development, and grants them an illusion of independence. The imaginative approach to their surroundings creates new associations for children to that given space. When you're a child, rooms are categorized by events and feelings. A space that would normally be a storage becomes be a hiding spot, since the child remember hiding there. While exploration is an important factor so is seclusion and privacy. The child needs a space where it can withdraw and feel in control. Small niches such as holes in the wall, a window placed low, or a bean chair in a more quite zone of the complex will facilitate places for shy children to withdraw when needed. Besides creating seating niches, a low placed window allows for smaller children to have a view of the outside, and allows for daylight to enter which have the same positive effect on children, teenagers and adults.

Younger children spend a lot of time playing on the ground, making floor heating and a soft ground surface the optimal solution in order to keep them warm and comfortable. Children do not posses the same ability as adults have, to evaluate the level of noise. Due to amount of time spend on the floor playing and the relative low height of a young child standing up, a vast amount of space is left empty, and therefore allowing sound to travel undisturbed. This scenario can easily create a high level of unwanted noise, which can lead to headache or stress. In order to avoid this it is important to understand the difference between noise that is air bourne, impact noise and flanking noise, and how to design solutions that solves these issues.

The choice of color and the tactile experience from different material is an important factor for children. Smaller children are often dressed in colored clothes and have toys with bright color palettes, which add a great deal of color to the environment. Color variation is important, as colors can be clearly distinguished by children and can act as a common reference, while also determine the mood in a given space.

Children often perceive their surroundings from a lower angle. Therefore, it is important to consider scale when designing. Creating spaces that allow access for the children to create new experiences, such as creating low placed windows, shelf, or for instance ramps near the kitchen to allow the children to observe or take part in a given task.

ill. 019: Sketch of a hanging couch


ill. 020: The patient and staff plays outside. (E W Beard Ltd, 2015)


ill. 021: The patient and staff plays outside. ((Bayt-Abdullah Childrens Hospice, 2014))

A Childrens hospice also accommodates young teenagers, which have different needs than those of younger children. A teenager wants a more quiet space, where they can play video games or watch TV, and prefers more subtle color palettes and less color variation. (Dudek, 2005) (Dudek, 2000)), (Rui Olds, A., 2001)

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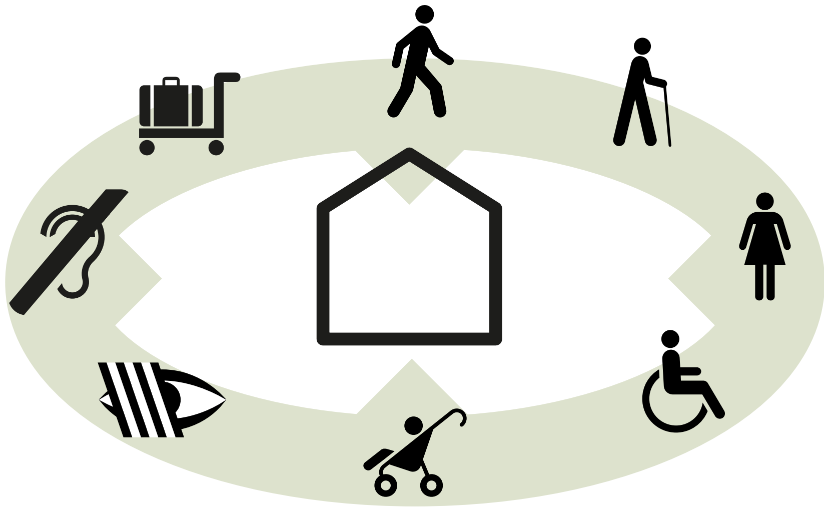
ill. 022: The patient and staff plays outside. (Wilmington Publishing & Information Ltd, 2016)



ill. 023: Universal Design Diagram

UNIVERSAL DESIGN

Universal design seek to accomodate every need for every age, size, functional capacities and nationality. Everyone has a disability, some may be permanent others may be temporary, some may have issues with sight, mobility, hearing, speech, touch, understanding, strength or sense of direction. Universal design seek to adapt design towards the different abilities each human has, making the building accessible and usable regardless of individual abilities.

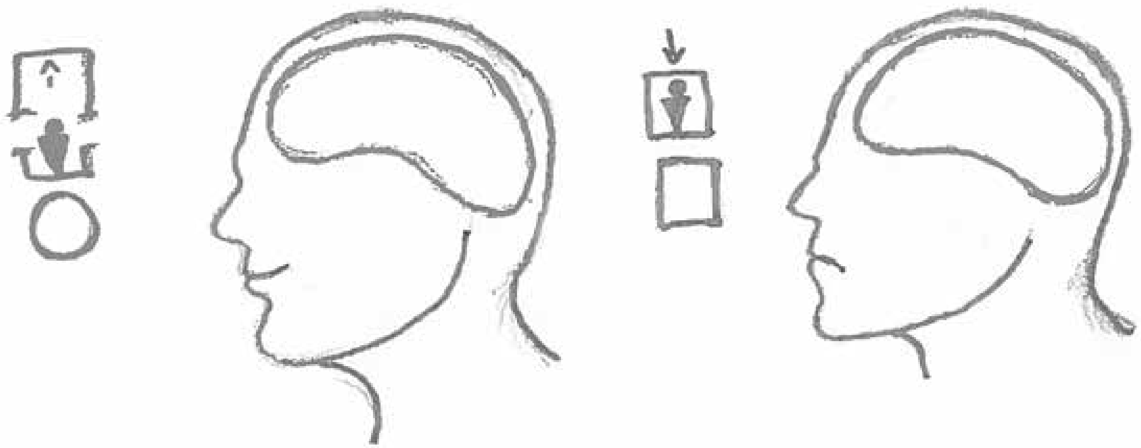
By using design principles from universal design, one can design/construct a building that can be used by all.

Some of the principles could be a level entry that can facilitate wheelchairs, but also people travelling with heavy luggage, or people with reduced mobility.

Large bathrooms are accessible by people in wheelchairs, whether the person is left or right handed or parents with small children in pushchairs or similar.

Pictograms is a universal language that could be used as signs together with braille, to help with language barriers or people with cognitive difficulties.

Allthough there's many different factors and solutions in universal design the key elements are to accommodate all abilities and all age groups, making spaces inclusive, participative and accessible for everyone, and creates an environment where everyone can retain their independence and agency. (Authority and Design, 2016)



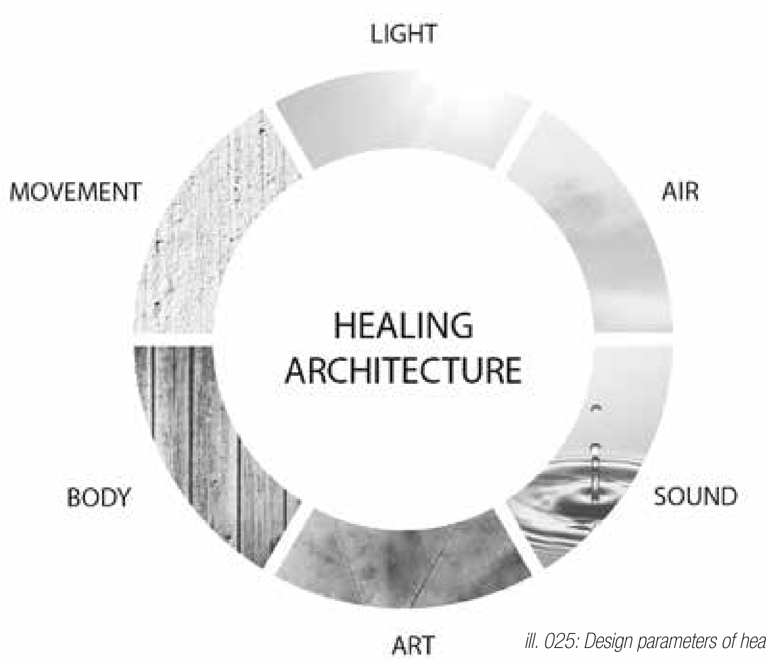
ill. 024: Illustration showing that circular forms affect one more positivley.

NEURO AESTETICS

Neuro Aesthetics is an architectural concept based on the theory; that the human brain has evolved its aesthetic principles as a response to its natural environment. Therefore, architectural space will naturally invoke primal responses in the brain. Design based on these neurological responses are Neuro Aesthetics.
The idea that humans are instinctively drawn to certain types architecture is not new. Theorists have throughout the last centuries, looked at the cradle of man as the source of true architectural shape. Whether It is an idealized hut or cavern. (Semper, 1989) (Laugier, 1966)
With the increasing knowledge of the brain and our evolutionary history, scientifically grounded theories have started appearing. One major road block in the neurological study of space, have been the instruments used in measuring the neurological responses. Neuro Scanners are massive machines where the subject is placed inside a claustrophobic space, which will naturally impact the studies. Studies using smaller but less precise instruments can still suffer from this spatial bias (Vartanian et al., 2015).

The research in Neuro Aesthetics is a wide field with a massive body of data, much of it not directly relating to Architecture. (Vartanian et al., 2015) The studies used in relation to this, test human perception and response to certain spaces. The two articles describe aesthetic valuation and approach/avoidance behavior. This was tested in relation to curvilinear or rectilinear spaces (Vartanian et al., 2013), tall or low ceilings and perceived open or closed spaces (Vartanian et al., 2015). The subject of the test were placed in an MRI scanner, in the scanner they were shown pictures of rooms of the different qualities that were tested. The subject were to respond whether or not they found the rooms beautiful and whether they wanted to enter or exit. The overall findings suggested, that spatial characteristics do indeed have an effect. Tall spaces were both considered more beautiful and would more often elicit an approach response. Prior test show that people prefer rooms around 0.61 meters taller than the standard of 2.44 meters (Vartanian et al., 2015). Open spaces were preferred to closed, although there were a distinction in the approach and avoid behavior whether the rooms were visually or kinetically closed. Kinetically closed rooms would provoke responses in the neurological centers associated with fear (Vartanian et al., 2015). Interestingly while curvilinear spaces were considered significantly more beautiful than rectilinear, the approach avoid response were equal between the two. Curvilinear spaces were found to activate centers related to wellbeing and reward (Vartanian et al., 2013). This is interesting since humans will in most other cases prefer curvilinear to rectilinear, rectilinear shapes will in most cases provoke something similar to an alert response. The reason architecture does not provoke similar responses may be because of adaption, since by far the most spaces we inhabit from birth are rectilinear (Vartanian et al., 2013).

When considering incorporating neuro aesthetic principles in a children's hospice. It is important to account the palliative value that can be applied to spaces that promote feelings of wellbeing and comfort from their base architecture. When considering patients that are bedridden, the ceiling structure would preferably of curvilinear shape. While open and tall spaces were favorites in these studies, it is important to consider the fact that patients in hospices may fell that they "disappear" in large spaces (Nissen et al., 2008). This can be accounted for by using furniture and room partitions to create smaller, more manageable niches.
When making a structure that in its pure form should be able to provide relief, it is extremely important to consider the neurological responses it will provoke. While the patients may be main subjects, it is also important to consider wellbeing of their families. This means that the different rooms should be shaped in response to the user.



ill. 025: Design parameters of healing architecture.

HEALING ARCHITECTURE

Healing architecture is an evidence-based design concept, that represent a vision on how architecture affect human well-being, but more so affect the healing process for the individual. (Frandsen, 2011)
The concept is not specifically that the architectural design and spatial conceptions can cure by itself. Healing architecture is meant as a support for the physical and psychological treatment that already exist within healthcare systems, defining the form and shape through the quality of the daylight, atmospheres, colours and sound.

Within healthcare design, there is an abundant of different parameters that creates significant complexity. Therefore, the theme of healing can be categorized into three groups; healing architecture, healing technology and healing design. Where healing architecture can be categorized as parameters that affect the architectural space as plan layout or window placement. Healing technology is the engineering specific part, as ventilation filters and lastly healing design is facilities and tools for aid. Even though there is a clear distinction between each group, they influence each other.

Healing architecture is split into three main factors: body, relations and security. Each of these is composed of subcategories that affect different parameters within the physical frame and the different side effects, being physiologically and psychological.

The body is related to the human body and senses and is divided into subcategories; light, art, sound, air, movement.

Light comes in different varieties. Diffuse, direct daylight and artificial lighting each have an influence on the satisfaction, orientation, circadian rhythm, sleep cycles, depression, time being hospitalized, mortality, pain, stress and errors. Research shows that daylight heavily influence each of these parameters. Rooms without daylight can affect one negatively with loss of orientation, time, introduce hallucinations and a higher margin for errors. Where rooms with the right amount of daylight and artificial light, positively affect depression, pain, stress and can be used as a form of therapy. (Frandsen, 2011)

Art is seen as a visual distractor and can affect ones well-being with sensibility, tactility or as a mental stimulator. Art can be manifested in a variety of forms, for instance with the use of different colour settings or a painting.

Sound is a key component when designing healthcare building. A heavy amount of equipment and staff mostly equals high noise levels, which creates discomfort for patients, relatives and the staff itself. One of the key factors in treatment is restitution, whether it be sleep or relaxation, these are both heavily influenced by noise levels. Whether it be undesired noise from a staff meeting, ventilation or high reverberation time which can disrupt sleep and impair restitution. Improving acoustics can positively affect the working environment by reducing the amount of errors, due to audibility. Music can in some ways be a distractor that can be used as a stress relief. (Frandsen, 2011)

Air can be perceived through temperature, moisture and smell, and affects comfort and well-being. Odor and draft can create discomfort and can cause spread of bacteria and vira.

With most healthcare buildings being complex, movement become crucial when designing. Wayfinding is a tool that specifically works with orientation. Well executed wayfinding can reduce time loss and improve effectiveness when moving through different sections within healthcare buildings.

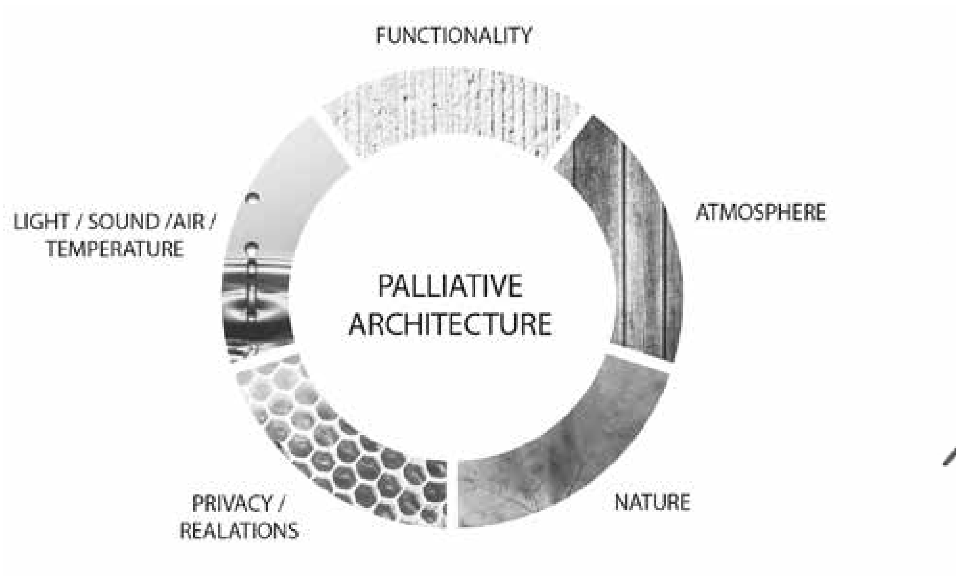
ill. 026: Image from Livsrum, Næstved, shows high amount of daylight through interior courtyards and skylights. (Realdania, n.d.)

ill. 027: Image from Livsrum, Vejle, the use of light materials and colors gives a brigther room and atmosphere. (ARCGENCY, n.d.)

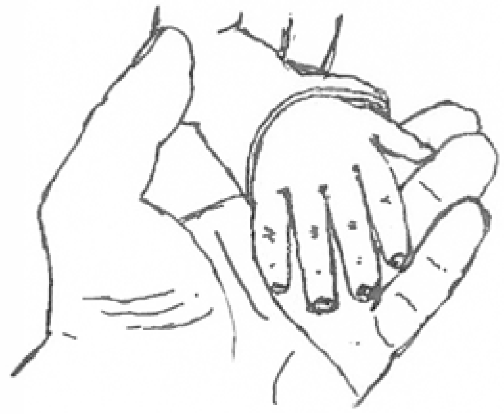
Personal space is about privacy, and can either be physical with walls or metal with the option to choose whether to talk or not. Privacy is important for creating confidentiality but also openness from patients, relatives or staff. Privacy is about being one self, but also giving comfort for examinations or discussions on the further treatment and side effects.

Social space is place for social interaction both on public and private level. Social interaction improves the well-being and happiness in a hospital environment, by giving space for social interaction for patients, relatives and staff. One can reduce the amount of anxiety, fear and stress while also reducing the time being hospitalized. Social spaces can be seen as therapy rooms to some degree. By placing social rooms away from trafficked paths the amount of social activities increase. By creating a homely feeling in public spaces, one can create a relaxing and comforting space for interaction whether it be confidentiality or social relations.

Creating a view towards nature and green environments has a positive response on humans physical and psychological well-being, concerning stress, concentration and pain. A view towards vegetation has a calming effect. (Frandsen, 2011)



ill. 028: Design parameters of palliative architecure.



ill. 029: The symbolic nautre of an childrens hospice.

PALLIATIVE ARCHITECTURE

The mindset behind palliative architecture is to strengthen the bond between the architecture and the palliative effect of the given facility. The design criteria's is defined as five aspects that intersect and influence each other.

- FUNCTION
- ATMOSPHERE
- NATURE
- PRIVACY AND RELATIONS
- LIGHT, SOUND, AIR AND TEMPERATURE

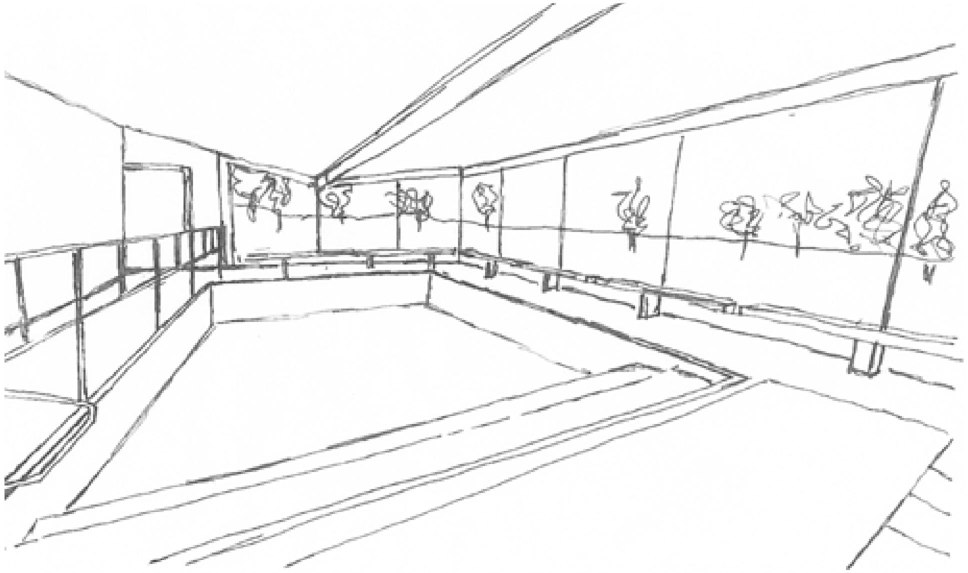
DESIGNING A HOSPICE

Palliative architecture is commonly integrated in the design of a hospice, nursing home, cancer center etc. When specifically designing a hospice, emphasis is put on creating a palliative setup that follows the strict criteria's necessary when dealing with patients in a terminal stage.
The concept strives to give people comfort they yearn for, and for the patients and relatives to feel well cared for, to be unburdened, and to find some sense of closure and peace. It is important to think of patients in the terminal stage as living, and treating them accordingly. A hospice should leave room for personal preference and aim to relieve both patients, relatives and staff during their stay and daily routines.

FUNCTION covers a list of the necessary elements that successfully needs to ensemble in order to carry out daily routines in an effective matter. Way-finding is essential when designing the floor plan. Simple floorplan solutions, with 90 degree corners, landmarks and universally understandable graphic to ease navigation, are all elements that help patients, relatives and staff to quickly reach their desired destination, and as a result minimize stress related to navigation. Accessibility is another key word. Patients often need a wheelchair or a bed in order to travel. In case of patients dying, coffin transport, is also a necessary element to include when designing doors, access roads, access area etc. Due to the typical state of a hospice patient, emergency buttons needs be reachable from the bed.
The design of a hospice should accompany a variety of arrangements such as music, birthdays, holidays or saying goodbye in the event of a patient dying. Meanwhile the hospice have to fulfill the needs of the relatives and the staff as well. The many different events demand a certain amount of adaptability. Placement of functions is crucial in order to accomplish an effective workflow. Depending on the relation and special needs of a specific function, it can be placed in a busy, isolated, noisy, quite, private or public area, etc. with the options of exploiting the synergy effect between different functions. (PAVI, 2016)

ATMOSPHERE is an important parameter in order for the patients to keep their sense of identity and self-knowledge. It is key to downplay the clinical expression, and aim to create a homely atmosphere. One way to achieve this is to allow the patients to bring personal belongings and integrate clinical equipment into the design in an anonymous manner. When designing a hospice, it is important to understand that affliction can come in both physical, mental, social and existential character. The idiom of the design should include recognizability. In that context the choice of materials, lighting, art, social space, furniture and the view, are important. Another significant aspect is the design of the arrival area, as it sets the stage for the first impression for patients and visitors. When deciding on the décor the level of comfortability dramatically effects how people perceive other people. The more comfortable, the better perception. The level of comfortability, self-knowledge and sense of identity is increased by creating a homely atmosphere. Most patients at a hospice is depending on the use of a wheelchair or a bed, and therefore the design of the individual units and common areas, should take the patients field of view into consideration.
A hospice often sets the stage for saying goodbye to member of the family. A hospice therefore needs a room that offers space for reflection, religious and spiritual thoughts. The décor of this function should take the modern multiethnic society into consideration.

NATURE as a design principle includes everything from a wild forest or a lake, to a simple picture of the nature in common areas. Visual and physical contact with nature have a significant effect on pain and stress relief as



ill. 030: Sketch of a basin for the patient to play with it's siblings.

ill. 031: Roof from Robin House, Scotland (www.brycelandtimber.com, n.d.)

well as minimizing the chance of depression. Nature has a positive effect on both patient, relative and staff, and helps to maintain a connection to life outside of the hospice. The more integrated the outdoor area is in a hospice, the more it is used. The outdoor area should aim to stimulate the senses of its user, who in this case often is bedridden or in a wheelchair. A scenario that calls for a sensory gardens that's relies on fragrance, sounds, wind or raises beds that stimulates patients with a limited field of view. The establishment of a playground would also serve to increase the mood of the patients, relatives and staff, as the sound and view of joyful kids playing is appreciated. (PAVI, 2016)

PRIVACY AND RELATIONS between patients, relatives and staff is very different from case to case. The option to choose whether the individual or group want to be social or private is critical when designing the floorplan. A solution with private wards and private bathroom accompanied by a separate room for relatives, is highly appreciated by both patients, relatives and staff. It allows for privacy, withdrawal, tranquility, etc. and relatives tend to stay longer and participate more intensely in the daily care of the patient when the hospice facilitate a more comfortable stay. (PAVI, 2016)

LIGHT – SOUND – AIR – TEMPERATURE falls under the category commonly known as the indoor climate. This design principle focuses on how the individual factors affects the user in relation to the experienced level of stress, anxiety and discomfort. Common for all parameters is that a certain level of individual adaptability is needed in order to accommodate the user. Individual adjustments of the indoor climate require some degree of understanding the mechanisms behind regulating temperature, shading, light level and air quality etc. Light have a positive effect on the user's general level of satisfaction, ability to navigate, sleep, mental disorders, depression, delirium, pain, stress as well as the risk of mistake during medical treatment. Tests prove that the amount of daylight a given patient is exposed to during the day, has a direct influence on the quality of sleep. The higher amount of daylight, the better sleep quality. An important note on this, is that the amount of light must be adjusted according to the daily rhythm of the patient. Light in general should also be understood as a tool for setting the correct atmosphere in changing scenarios. It can vary from an intense light source during medical treatment, to the dim lighting of a candle in the scenario of saying goodbye to a family member. Sound is also an important element as it have the ability to either heal or be disturbing. Music, wind blowing through the treetops, birds singing or the sound of running water seems to have a positive effect on both the patients, relatives and staff, when it comes to stress, distraction, pain, calmness and the amount of re-admissions. Noise from technical equipment, staff, relatives and other patients on the other hand, have quite the opposite effect and pushes the course of treatment in a negative direction. The acoustics and sound proofing of a patients unit, also affects the patients and relative's experience of privacy, which in some scenarios makes the patient retain important information from the staff. Air quality is especially important in a hospice due to changing scenarios of a patient in the terminal stage, varying from a minor feeling of nausea to the stage of necrosis. In the other end of the spectrum, the fragrance of a specific flower, might just be what takes the patient a trip down memory lane, and thereby adds quality to the life of the patient. Hygiene is another important aspect that's needs to be taken in to consideration, and therefore a hospice needs a ventilation system that can adapt to different scenarios, while adding a minimum of noise to the patient units. Lack of influence on the room temperature leads to discomfort for the patients and relatives, and further more adds to the feeling of disempowerment. Some extent of individual control on the indoor climate is recommended. (PAVI, 2016)


ill. 032: Family Enjoying breakfast together (Dalum, 2009)


ill. 033: Kids playing on the couch (Public Domain, 2016)


ill. 034: The daughter observes her mom (Lønbro Frandsen, 2012)

THE HOME

In palliative treatment a space of security and continuity is needed, these values are commonly found in the home. (PAVI, 2016)

Objectively people in the western hemisphere will see the home as house, this can differ between cultures and countries. In Western Europe and the Americas, most would consider a home a single-family dwelling. There are also temporal and cultural associations to the home, like ones place of birth or ethnicity can invoke feelings of homeliness. In this project the focus is on the home as a physical object as defined by its inhabitants. (Coolen and Meesters, 2011)

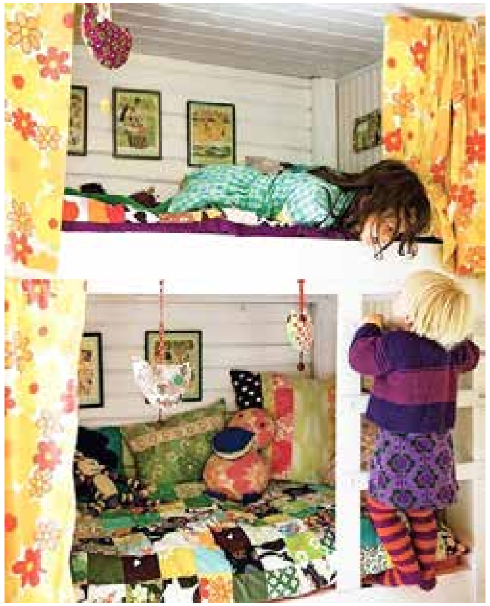
The home is associated with a retreat away from the stress of the workday, a place where one can restitute. In the home, the day-to-day experiences play out. The experiences obtained within the house are a large part of what makes it a home (Meesters and Coolen, 2009). Therefore, it is important that these everyday situations follow the families into the hospice, and that the building can provided spaces for the mundane to play out in the extraordinary situation. (Hørlück, S. 2016)

The home is a personalized space where objects gathered and arranged by the inhabitant to appease them in a meaningful fashion. This is a way for the inhabitant to feel at peace with oneself but also a way to express themselves and create an identity for themselves. The home is therefore a frame for social interactions between friends and families. (Meesters and Coolen, 2009)

A hospice as an institutional facility will need to be designed in such a way that it can create feelings of homeliness and belonging in the patients. (Pavi, 2016)

Often hospices will for this reason be very lenient on allowing personal furniture and trinkets to be brought into the building. It is important to allow objects of affection to the patients to define the space they have to inhabit. Therefore spaces need to be customizable with a great degree of flexibility when it comes to furniture. (Hørlück, S. 2016)

ill. 035: Time spent with the family often include games (Simonsen, 2016)



ill. 036: Siblings uses the room to interact (Møller, 2012)

ill. 037: Family gaming together (Femina, 2016)

ill. 038: Family quality time (DAYZ Resort, 2016)

ill. 039: The vegetation and forestation near Pebermosen.

NORDIC

If one should describe something as nordic, it's the diffused nordic light. A light giving matter form in different ways with it's ever changing light. Where the southern countries are predominantly affected by direct sun light.

In the nordic countries, light influences all things with a mood. On the contrary, the south has one mood when sunlight encompass all things.
When designing architecture one must consider the nordic light and it's possibilities to change the mood of a whole room with it's diffusing light that manifest and change as day turns into night.

"For it's precisely light that defines the Nordic World and infuses all things with mood. Light informs us that we are no longer in the south." (Norberg, 1996, p.2)

Space in the Nordic countries consist of unsurveyable terrain covered in dense forests, that creates a thicket. Norberg describes this as an indistinctual web. In order to grasp and gain foothold on this web one have to create an opening in the thicket, a clearing. By creating this clearing, one manifests an aperture that dissolves the continuity of the web and creates a space that eventually becomes a home; a known place in an unknown place.

"In the North, we live among things instead of in confrontation with them." (Norberg, 1996, p. 15)

The building tradition in Nordic countries centralizes around the landscape and environment by the use of materials and tactility. An example would be using local grown timber, which is adapted to the local environmental effects. By using simple construction systems, such as the gable roof, one can use locally materials as a barrier handling the heavy snow load.

"Visualization of a place occur in two ways; either in representing the given in a corresponding architecture or in complementing the given by adding that which the environment is missing" (Norberg, 1996, p. 17)

ill. 040-B: The Serpentine Pavilion by Toyo Ito, is a definitive example of using computational tools to determine the aestetics from structural parameters. (Deleu, 2007)

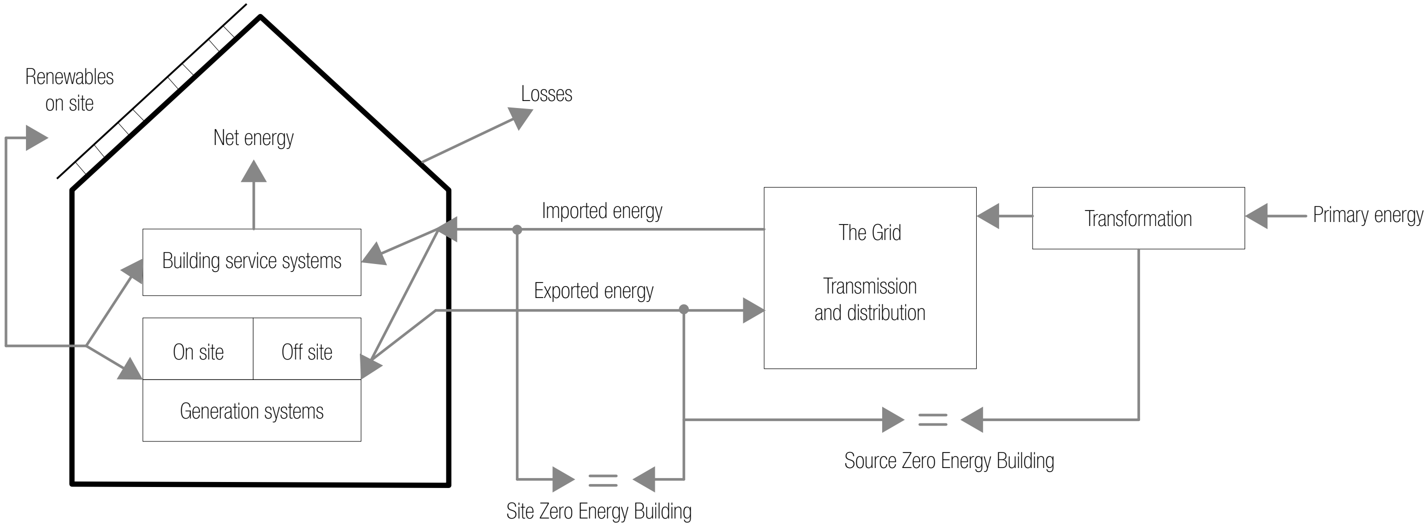
ill. 040-B: Bagsværd Church by Jørn Utzon, uses the structure to define the space with light and accoustics as a parameter. (seier+seier, 2011)

TECTONIC

Tectonic is a definition of balance between structure, construction and aesthetics. Tectonic form and shape is an expression of the properties of a given material, affected by certain factors that determines it's form. The tectonic approach cannot be seen as merely exposing structure; it is about creating atmospheres and experiences when moving through or occupying spaces.

"Tectonics is the seminal concept that defines the nature of the relationship between architectural design and it's structural properties." [Oxman, 2009, p. 195]

With the introduction of digital tools in architecture and engineering the relation between architectural design and the structural properties have shifted to a more uniform process, where computational tools help determine architectural form through the means of optimization of technical properties, such as acoustics or carrying loads. This results in the structural and material properties determining shape and form. [Oxman, 2009]
By using digital tools one can establish an iterative process by creating feedback loops, that results in an embodiment of tectonic that determines the spatial idea and atmosphere.



ill. 041: Diagram showing distribution of energy

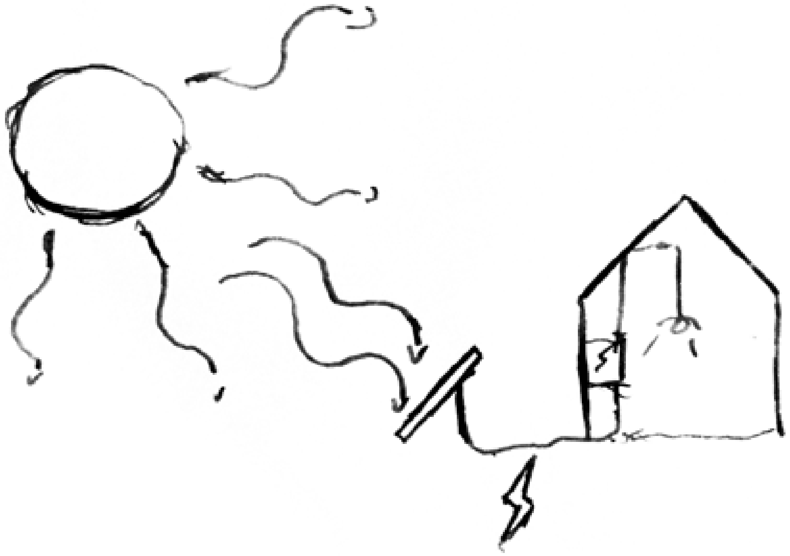
SUSTAINABILITY

Concept of sustainability:
Sustainability is the idea that the planet's resources and environment are finite and fragile. Therfore, humanity has the obligation to uphold the environment and minimize the waste of finite resources.

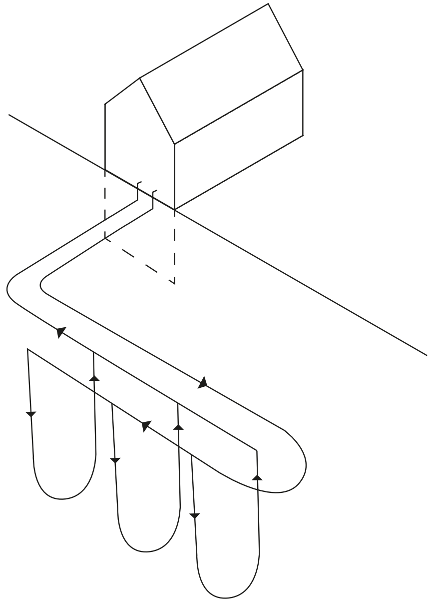
Zero energy buildings:
A zero energy building (ZEB) is a building that produces the same amount of energy that it consumes. If the energy it consumes is not directly, what it produces isolated from the grid it is called netZEB. NetZEB are a building that sends back the same qualitative amount to the grid as it consumes. (Larsen, 2015) (Marszal et al., 2011)
The Quality of the energy is determined by the difficulty and waste in the production. Heat being the waste energy from many processes and easy to produce is low quality. Electricity that requires a larger and more wasteful infrastructure are considered high quality. When calculating the energy consumption of a building, the unit of measurement is an abstract primary energy, where the different types of energy usage is multiplied according to their level of quality. (Larsen, 2015)
Net zero energy buildings are placed in different categories based on how far back in the supply chain, the buildings energy consumption is calculated. Whether it is the immediate use and production on site, or calculating back to the energy used to produce and transport the fuel for the electrical production. (Larsen, 2015)

Sustainable goals:
The aim for the building will be to follow the 2020 requirements.
A hospice is very dense with a lot of human and electric activity, therefore, it is not going to be a problem to fulfill heating requirements. The problem is the usage of electrical energy.
A hospice, like nursing home and hospitals are twenty-four hour buildings (Nissen et al., 2008). There are spikes of activity in the day and afternoons. Most treatments take place during the day, but many relatives may not be present before afternoon or evening. There are going to be an energy spike around dinner time, when both families and central kitchen is being fully worked. This means utilizing electricity produced by renewable sources like photovoltaics, happens while the large parts of the consumption takes place.
The problem arises from the fact that there still is a significant consumption in the late evening and night. There will always be power intensive machines and procedures 24 hours a day.
Producing the energy can prove problematic too. There are direct sunlight from the east and south, for most of the year. But this light is blocked by the forest in the afternoon. Angling the photovoltaic panels to the southeast will be ineffective compared to the day long exposure from the south (Larsen, 2015).

Much of the vegetation around the site is leaf forest, as the trees lose their leaves in the winter the low sun will penetrate somewhat.
Wind power is out of the question, since the forest shelter from the wind effectively. If wind power should be utilized the turbines need to reach above the forestation.
To meet heating demands it will be preferable to utilize a vertical brine to water heating pump system. Brine to water is more energy efficient than air to water or water to water. Vertical pipes are more efficient and therefore preferable to horizontal. A Brine to water heat pump can only provide temperatures of 55 degrees Celsius, therefore a large heat dispersion surface (for instance floor heating) are required. (Energistyrelsen, 2012)



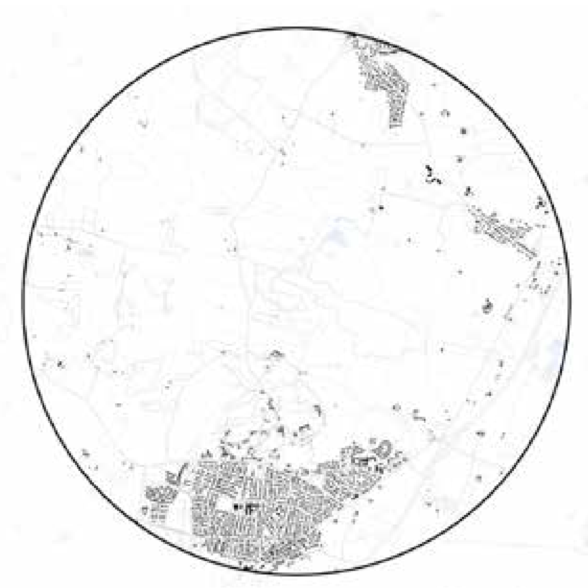
ill. 042-A: Photovoltaics producing electrity by the use of sun radiance.



ill. 042-B: Brine to water system producing sustainable heat by using the passive heat storage with the ground.

Conclusion
In this case the building has high electrical demands, and the site may prove problematic in on site production of electricity. But the building will generate plenty of waste energy for heating, while plenty of planning and digging will allow ground heat systems to be installed. Heat generation and cooling should prove unproblematic.
Therefore it seems like the more realistic goal to aim for a 2020 building rather than full ZEB.


ill. 043: Diagram showing roads and acces to the site.


ill. 044: Diagram showing nearby buildings and towns.


ill. 045: Diagram showing the protected area in Hammer Bakker.

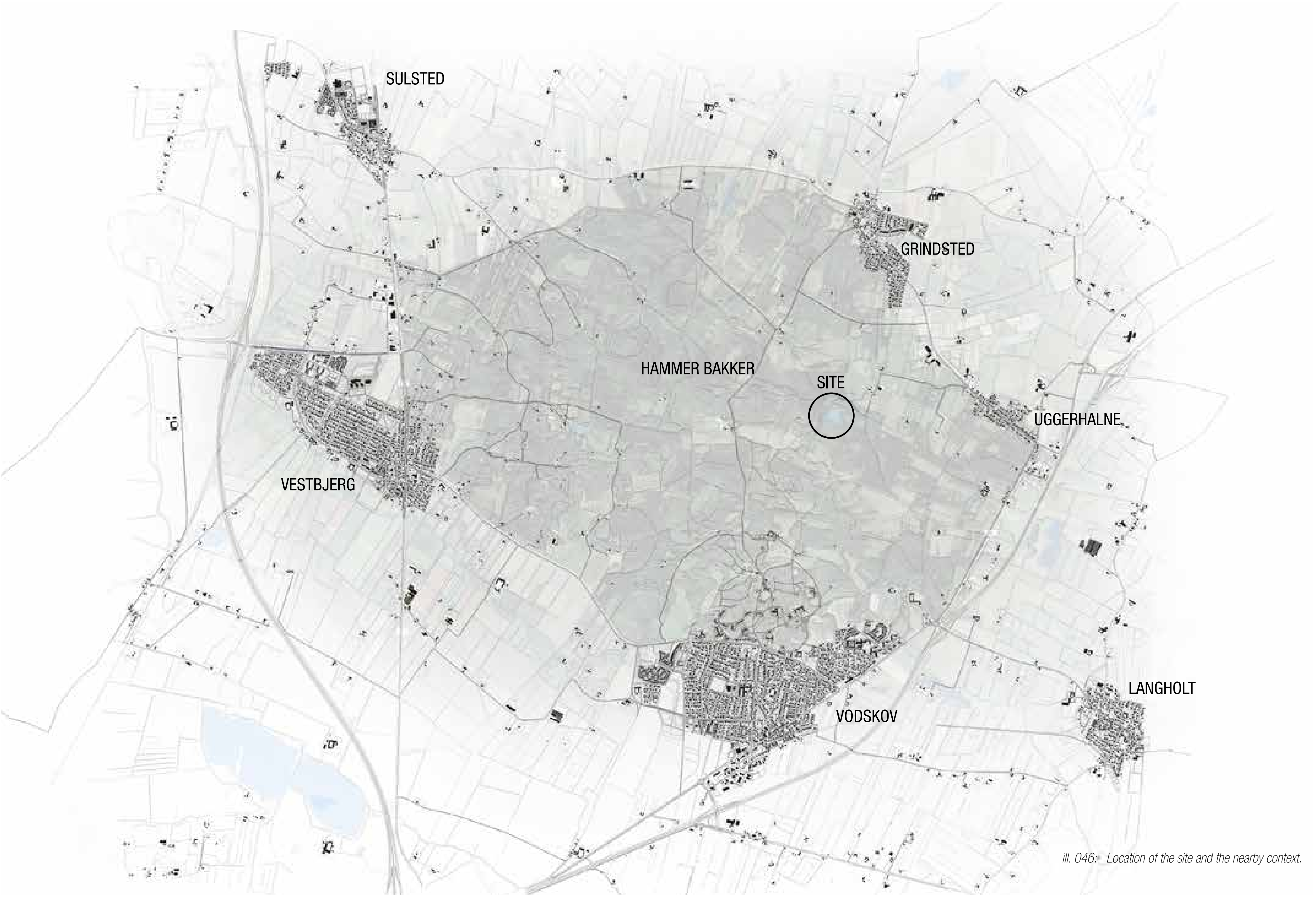
SITE ANALYSIS

Hammer Bakker was an island before Denmark rose from the sea bottom after the ice age, this results in the area having an unique landscape. While the surrounding land in Northjutland contain very large deposits of chalk in the composition, Hammer Bakker is mostly sand and rocks. Therefore, Hammer Bakker were sparsely populated, since the sandy earth were not desirable for farming. Lumber production took place in the hills, which are evident in the forest.
While the population were sparse, there are archeological evidence that the area may have housed a holy site for the Norse pagans. In the 17th century the hills were used as place of trial and execution for the nobles in Aalborg and the surrounding area.
Pine trees with clusters of leaf forest dominate the area. Because of the composition in the earth only few streams and lakes exists. The wet areas that do exist are bogs filled with floating peat islands. The foundation for the islands are a kind of floating moss call Sphagnum. In these bogs, special conditions for rare species of plants, insects and birds are present. Allthough the area is vastly inhabited by invasive plants that the muncipality of Aalborg wishes to eradicate. (Naturturist.dk, 2016)

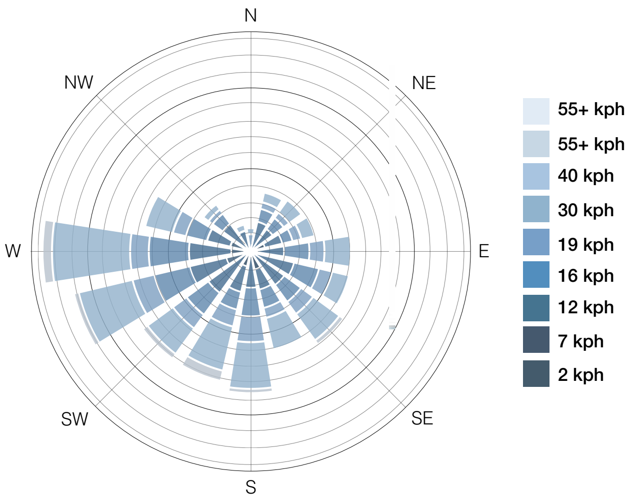
The landscape shifts between dense forest dotted with clearings, and open heath overgrown with heather where flocks of sheep wander.
The forest around Pebermosen is dense and allows diffuse and filtered light to penetrate, the trees shelter from wind and sound. The atmosphere is one of tranquil beauty and silence. Mosses overgrow tree trunks and a thick carpet of vegetation covers the ground, the forest seem ancient and forgotten, the illusion only broken by recent tire tracks and the occasional wanderer.
The brightening glare from Pebermosen's dark waters signifies change in the forest. Standing at the water's edge, the contrast between the bright sky and the forest is intense.
There are several villages placed on the edges of the hills. These contains institutions that benefit from being near a quite natural environment. There have been a historic precedent of placing institutions in Hammer Bakker. (Naturturist.dk, 2016)

The chosen site is a small hill resting on the western shore of Pebermosen. The hill is sheltered by the woods from all direction, only opening up to the lake on the east. The site is connected by paths to the surrounding towns.
The trees shelter from the wind, while the lake is open, the tall vegetation surrounds it and breaks the wind. This is ideal for the hospice since it makes the outdoor areas more available and hospitable to the patients. When planning out the changes to the site it is important to consider whether or not the sheltering effect might be broken, if too open spaces are planned.
Sun falls onto the site from the east, and the reflection from the lake does increase the diffuse light levels.
In planning it is important to consider how to get proper levels of sunlight onto the right areas of the site. Shadow diagrams and insolation analysis are unpredictable under current condition, the site will likewise undergo major change making these analysis of little consequence to the kind of project.

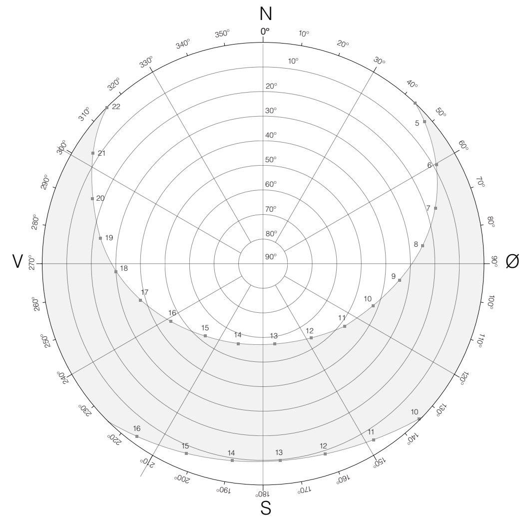
Protection status:
Parts of Hammer Bakker is protected per regulations of December 2015 (Natur- og Miljøklagenævnet, 2016), this area includes 165 ha of land south of Pebermosen. A much larger area used to be protected, but all protection was removed in 2012 only to be reinstated in its current form in 2015. Pebermosen is not included in the protection. There are no current local plans on the site. (Natur- og Miljøklagenævnet, 2016)



ill. 046: Location of the site and the nearby context.



ill. 047: Windrose of Hammer Bakker. (Autodesk, 2016)



ill. 048: Sun diagram showing the span in hours from summer to winter.

WIND

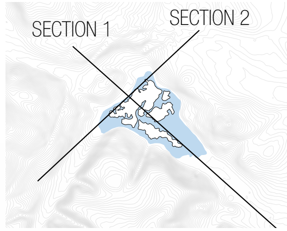
The primary wind direction is west and southwest. The site is only open to the east and southeast and therefore sheltered from the most powerful wind direction. From the south, west and north the site is sheltered by forest, and hills.

SUN RADIATION

Sun can fall on the site from the east and south southeast. The rest of the day, foliage will block out direct sunligt, with the exemption of the penumbra effect (Smith, Knapp and Reiners, 1989). In winter when the sun is low, the primarily deciduous trees on the site shed their leaves, leaving only the trunks and branches to block out sun

Sun will penetrate with the penumbra effect, where openings in the foliage will act similar to a camera obscura. This will produce bright spots with overlapping sun rays called numbra. Around the numbra is a shadowed halo called Penumbra. A study on subject predicts "*A maximum of <5% of full sun possible for <1% of the total time of exposure to this maximum*" (Smith, Knapp and Reiners, 1989, p. 1607) for "*closed deciduous forests*" (Smith, Knapp and Reiners, 1989, p. 1607). While "*open leaf canopies/dry conifer forests*" (Smith, Knapp and Reiners, 1989, p. 1607). are "*Full Sun possible but only for ≈30% of the total exposure period*" (Smith, Knapp and Reiners, 1989, p. 1607).

SECTION



ill. 049: Section from Southwest

ill. 050: Section from Southeast

ill. 051: Path at Kamillianergården: An open garden placed south of the building providing sunlight most hours of the day. Flowers and decorations create a beautiful environment, that emanates privacy in center of Aalborg. (Hospice Forum, 2016)

ill. 052 Arrival At Robin House: Robin house embraces the arrival, a warm wood surface funnels the arriving families towards a small door in human scale. Above the curvilinear roof rolls along the straight edges of the walls. (Lee, 2005)

THE ARRIVAL

A hospice is a place of relief. The patient is relieved of symptoms and pain, and just as important, the relatives are relieved of emotional stress. This stress will be more pronounced when the patient is a child and the relatives the child's parents and family.

The arrival and departure are key in this aspect of palliative care. When arriving at the hospice, the family will in most cases come directly from a hospital. Hospitals are stressful environments, sterile and anonymous. (Hørlück, 2016)

Arriving by car; the child and family will arrive at a drop off point in front of the building, this spares the child from physical exertion. It also changes the first impression from a barren parking lot, to the intended entrance.

The arrival at a children's hospice should be comforting and embracing. The approach before reaching the front door, must not stir feelings of cold institutionalism.

The approach to Lukashuset is less than desirable. The route from the parking lot follows through an old hospital building, shared by language-students and employees from other areas of the Lukas Foundation. At the end of long tall winding hallway, a tiny white anonymous door signifies the entrance. The departure takes place at the same route.

The importance of an ideal and memorable arrival and departure for the family must be stressed. The trauma of losing a child is devastating and hard to recover from. Therefore making the last time of child's life pleasant while allowing the family to carry away their departed in a dignified fashion, are a major part in palliative treatment.

The departure should above all be picturesque and discrete; this is the final goodbye to the departed child. Today the prevalence of cameras should be considered and embraced. Since the families will be taking pictures of the event the picturesque nature of the departure should complement the photographies.

The departure should not feel like "being shoved out the back door". While certainly the event may rub off on other families this is to be expected, and may be part of the acceptance process for the other families. (Hørlück, 2016)

Conclusion:

The arrival and departure are essential components of a children's hospice. The arrival should signify peace, comfort and safety while the departure should be dignified and beautiful. Utilizing a path through the natural landscape and gardening is a must. While the arrival are equally important for the child as its family, the departure is essential for the families healing process.

ill. 053: Flexible common room in Lukashusets: by allowing the hanging lamps to be moved along rails, the room are not bound by what would normally be very static furniture.

ill. 054: Interior from Tietgentkollegiet, by Lundgaard og Tranberg. A movable cabinet and flexible storage space adds significant functionality to the apartments. (Tietgenkollegiet.dk, n.d.)

FUNCTIONALITY

Functionality is essential when designing a hospice. But the importance is not in including the functionality, but in the integration of functionality with a feeling of comfort and homeliness. It must be stressed that the distinction between a medical treatment facility (like a hospital) and a hospice is clear. (Hørlück, 2016)

Functionality is important for both the child and staff. There needs to be the necessities like lifts, adjustable beds, oxygen and so forth. In hospitals these elements will be integrated at the top of the bed, making the equipment an obvious reminder of the situation the child is in. The trick is to either hide the necessary or make it mobile; it should only be visible in the room when it is used. (Nissen et al., 2008) (Hørlück, 2016)

Flexibility is in the case of a hospice solidly linked to the functionality. The different children will have wildly different conditions and therefore require different equipment in the patient unit. The patient units need to be completely flexible, with as little static furniture as possible. The patients and families should be allowed to bring their own furniture and decoration, to make the unit as comfortable and homely for them as possible. (Hørlück, 2016)

The patient units should likewise facilitate larger or divorcé families. Therefore two units could have the ability to be joined if one is empty. Empty units can be used as impromptu conversation rooms or emergency rooms (Hørlück, 2016).

Common rooms should preferably be very flexible too; the furniture should be mobile and allow niches to be formed as needed.

Placement of the staff should happen with respect to the distance the staff will be required to travel each day. There will arise situations where staff should have clear path to patient units. (Nissen et al., 2008)

Accessibility should be planned to allow bedridden patients to be easily transported around the facilities, even the outdoor gardens should be accessible bedridden. Many of the patients will not be able to even use a wheelchair. The patients should therefore be transportable without staff help for the families. (Nissen et al., 2008)

ill. 055: Niche from Fremtidens Plejehjem, Aalborg, shows storage/meeting space in the puplic area. (Nordjyske møbelfabrik, n.d.)

ill. 056: Niche from Fremtidens plejehjem, Aalborg. Illustrates the creation of a private space within a puplic space. (Aalborg muncipallity, n.d.)

NICHES

The placement of social and private areas in a plan structure of a palliative care facility is of great importance. Considerations on the diversity of common areas can be taken into account by placing smaller transition zones or niches, and thereby avoiding a direct collision between social and private rooms. (PAVI, 2016)

Niches can be used as landmarks and improve the wayfinding and thereby increase the sense of security for the patients. They can function as a way of breaking up long corridors, or marking an entrance to a patient unit as seen in the future nursing home (fremtidens plejehjem) in Aalborg. In Sankt Lukas huset in Gentofte, niches was created by changing the colour or material of the floor or wall, or by placing a piano or an aquarium alongside the wall of a main corridor. Both the piano and the aquarium worked well as unformal gathering spot as well as generating a joyful atmosphere for both patient's relatives and staff.

Patients in the earlier terminal stages, benefits from having niches that facilitate an unformal social activity or knowledge sharing with a fellow patient. As a result the patients experienced an improved level of stress and wellbeing. The same test also show that niches is mostly used for the unformal meetings between relatives and staff. (PAVI, 2016)

ill. 057: Niche in a window sill, that can either be used as a decoration spot, or a place to sit.

ill. 058: A hallway becomes a small area for relaxing by creating a small spot, with furniture within the hallway.

ill. 059: Hallway in Hospice Djursland (Mørk, 2016)

ill. 060: Maggie Center Glasgow Courtyard (Turner, 2014)

ill. 061: Hallway Robin House: From the glass ceiling light falls onto soft solids, the hallway facilitates niches through space material and color. The space is light but intensely private. (Andrew Lee Photography, n.d.)

FLOW AND TRANSPARENCY

The hospice flows between different levels of privacy. Some functions need to be very apparent and open, this includes the staff watch room where the patients and families always needs to be able to engage the staff. This creates safety for the child and family, and it enables the staff to quickly respond to escalating situations. Lukashuset is based on two axis, at the intersection the watch room is placed and marked with a neon sign.

Privacy is essential for the child and family in the hospice, therefore the patient units should block view directly into it from the hallways and the exterior. Daylight should be plentiful, and a beautiful view is only positive. Therefore, blocking views into the units must be achieved by landscaping.

The flow in a hospice should be easy to comprehend. Many hospices use the intersecting axis to create an easily interpretable floor plan with an easily manageable room hierarchy. In newer hospices there have been an increasing prevalence of the circular plan. In a circular plan it is impossible to get lost, every room and function can be found by walking in one direction. This also allows for functions connected to most of the hospice, to be placed in the center. The flow will be circling around the center, while staff can make radial movement from the center into the peripheral.

Common rooms should stand as opposites to the dreary situation of the child. Games and play can take place and interaction between children and families should be encourage with common elements. This could be pianos or an aquarium.

Most hospices utilize shifting transparencies as one moves through the building. The hallways are littered with high placed windows that allow the spread of diffuse light.

ill. 062: Patient Unit Hospice Djursland: A window is placed directly above the bed, light is diffused into the room by the curviliniar ceiling. (C.F. Møller, n.d.)

ill. 063: Ronald McDonald House Copenhagen (Bjørløw Jacobsen, 2016)

ill. 064: Niche Gartnaval Maggie Center: The dark wood cladding contrasts the overhead windows. The pattern in the cladding slithers along the curving walls. (Turner, 2014)

ATMOSPHERE

A hospice is often described as being founded on a special palliative atmosphere that relies on a great level of adaptability according to the needs of the patient and relatives. The spirit of a hospice needs to accommodate both physical, psychological, social and existential suffering. The atmosphere should reflect a safe, calm and dignified character.

The atmosphere of a children and youth hospice is of great significance to the well-being of the patient, relative or staff. If a given space is designed mainly on functionality, by letting equipment and a general clinical atmosphere be dominating. It might result in patients feeling deprived and powerless. If a patient on the contrary is allowed to bring personal objects and the clinical expression is minimized without effecting the level of usability and safety, patients and relatives tends to create a homely atmosphere. This affects the patient's level of stress in a positive manner, while the relatives tends to stay longer and become more involved with the care and nursing of the patient.

Familiarity play an important role in creating a comfortable and homely atmosphere. The choice and placements of elements such as paintings, materials, lighting, art, social areas, choice of furniture and the view is all of great significance in order to achieve the wanted result.

The décor affect how we see and experience other people. The décor of common areas plays an important role as a well-designed common area with the right atmosphere, as seen in the Sankt Lukas hospice in Denmark, tends to attract more patients. This has a positive effect on the degree of social interactions and the experienced level of comfort.

Art have a palliative effect on people. Art of various kinds can serve as a distraction, and create a positive recreation as seen in the design of the ceiling at the Robin house hospice centre in Scotland. Art also seems to have a calming effect and at the same time work in favour of lowering the clinical expression of a hospice.

In a hospice there is a need for a certain amount of flexibility. The atmosphere should be able to embrace the emotional width of saying final goodbyes to playful social events. The lighting is crucial when it comes to setting the right atmosphere, and an adaptable lighting system should therefore be installed. (PAVI, 2016)

ill. 065: The surrounding forest of pebermosen

MATERIALS

The choice and combination of different materials is important in the search for specific atmosphere and expression. The choice of material helps the visitor read and understand a room in a certain way, and effects the indoor climate both in a physical and psychological manner.

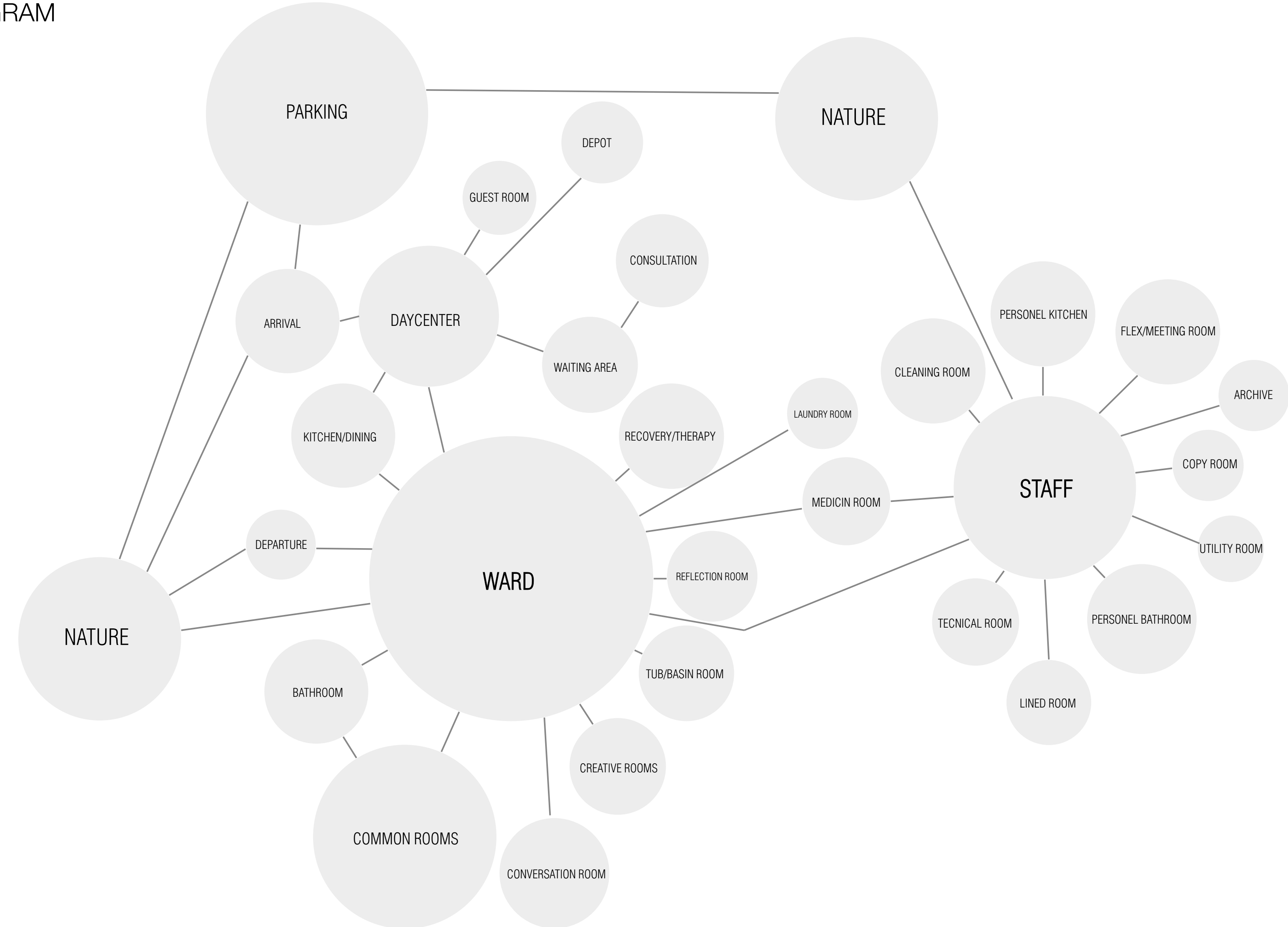
The acoustics of a space is affected differently by materials and the interior of a space can be viewed as instruments that either absorbs, reflects or scatter the soundwaves.

Materials also affect the temperature of a space both in a physical and mental aspect. The tactility of materials as steel or concrete often feels harder and colder than for instance wood. But the effect is even more present in a when it comes to seeing and feeling the space.

Materials greatly affects the way a space is perceived and understood. Not only by tactility or seeing, but by stimulating all of our senses into thinking and imagining a certain atmosphere. Due to typical use, some materials reference certain places and feelings connected with that place. The combination of some sort of wooden floor, combined with tiles in the wet areas, is a classic choice for dwellings, and will in many cases help to reference a homely atmosphere. Materials as vinyl and linoleum is often found in places such as hospitals and other clinical institution, and will therefore in many cases reference the atmosphere found in such places. (Zumthor, 2006)

Sustainability and maintenance plays a role when choosing the materials for a project. Concrete is cheap to use and well suited for designs of organic shapes. Steel offers a large degree of freedom and strength to the design. The use of clay bricks has a long and proud tradition in Denmark when constructing urban blocks and private dwellings. Common for both concrete, steel and clay bricks is a relative long life span, but all of them uses non-renewable natural resources combined with a large co^2 footprint regarding production. Wood is a natural and renewable resource with a low co^2 footprint, which depending on the sort of tree can have either a short or a long reproduction time. Exposed wood offers great attributes to the indoor climate, but in most cases have a high degree of maintenance. A variety of technologies do allow for wood to be treated in order to reach a lower degree of maintenance as well as using softer tree sorts as fir or pine.

FUNCTION DIAGRAM



ill. 066: Function diagram.

PATIENT FACILITIES

FUNCTION	AMOUNT	SIZE	TOTAL	NOTES
Patient / Family unit	10	60 m^2	600 m^2	- Unit split into 2 rooms with a private bathroom - Must have its own terrace - Direct acces from hallway to both rooms - Outfitted for disabled - Must accomodate families and relatives
Common Room	1	min 60 m^2	60+ m^2	- Nonformal meeting place for patients, relatives and staff - Must be accessible and fitted for disabled including bedlaying patients - Flexible lighting and furniture
Daycenter	1	min 120 m^2	120+ m^2	- For social activities and events - Provide space for lesser ill patients and relatives that doesn't live on the hospice - Must have kitchen and dining space - Access to outdoor area
Dining kitchen	1	40 m^2	40 m^2	- Refrigderators with space for the different families - Fully equipped kitchen that allows families to cook and dine together
Creative Rooms	3-4	25 m^2	100 m^2	- Physical therapy - Music - Drawing - Movement
Guest Rooms	2	12+6 m^2	36 m^2	- Rooms for staying the night - Isolation in case a relative gets ill.
Cantina + kitchen and pantry	1	170 m^2	170 m^2	- Serving for patients and relatives
Reflection room	1	min 20 m^2	20+ m^2	- Spiritual and solitary reflection

TREATMENT FACILITIES

FUNCTION	AMOUNT	SIZE	TOTAL	NOTES
Recovery / Therapy Room	1-2	20 m^2	40 m^2	- Room for stimulating all senses - Adjustable Massage beds and chairs - Must be accessible - Avoid mirrors
Conversation room	2	15 m^2	30 m^2	- Private room for private discussions with staff
Tub room	1	30 m^2	30 m^2	- Bath used for pain relief - Focus on sound, light and visual impressions - Allowance for daylight, but restrict view into room.
Basin room	1	60 m^2	60 m^2	- For therapeutic treatment - Social interaction with siblings
Consultation room	1	15 m^2	15 m^2	- Massage bed - 2 chairs and a desk - Sink - Close to staff area
Waiting area	1	5 m^2	5 m^2	- Close to consultation

UTILITY FACILITIES

FUNCTION	AMOUNT	SIZE	TOTAL	NOTES
Lined room	1	10-15 m^2	15 m^2	- For clean lined and mattresses
Flushing room	1	15 m^2	15 m^2	- For cleaning and boiling equipment
Waste room	1	15 m^2	15 m^2	- Easy acces for garbage truck
Cleaning room	1	10 m^2	10 m^2	- Facility for cleaning
Technical room	2	20 m^2	40 m^2	- Technical maintainance
Utility room	1	20 m^2	20 m^2	- Office and workshop for janitor
Remote depot	1	80 m^2	80 m^2	- Can be placed in basement - Allow for tranportation of larger equipment and beds
Laundry room	1	10 m^2	10 m^2	- For staff and relatives - Possible for seperation between staff and relatives.

PUPLIC FACILITIES

FUNCTION	AMOUNT	SIZE	TOTAL	NOTES
Arrival area	1			- Main entrance for patients, relatives and staff - Should reflect a positive atmosphere
Departure area	1-2			- Coffin transport - Discreet and dignified
Outdoor area	1			- Accessible for patients and relatives - Must be fitted for disabled
Parking space	35			- Parking for Staff and relatives - Should include a dropoff zone close to the arrival area - Pick-up for funeral carriage for departure route
Staff watch	1	20 m^2	20 m^2	- Public and central - Visible upon exit of patient unit

STAFF FACILITIES

FUNCTION	AMOUNT	SIZE	TOTAL	NOTES
Meeting room	1-2	15 m^2	30 m^2	- Flexible
Offices	3	20 m^2	60 m^2	- Should facilitate different teams
Personel kitchen and dining	1	50 m^2	50 m^2	- Staff only
Copy room	1	10 m^2	10 m^2	- Staff only
Archive	1	30 m^2	30 m^2	- Administrative paperwork
Staff changing room	2	40 & 20 m^2	60 m^2	- Split according to sex, 40 Female, 20 male
Medicine room	1	12 m^2	12 m^2	- Locked and for staff only

FUNCTION

Navigational ease

Central Personnel

Absolute accessibility, also outdoors.

Integrated and flexible equipment

Flexible common rooms and niches

Single floor plan

Separation of arrival and departure

Separation of children and young adults

Flexible patient units to account for large or modern family constellations

Material choice should consider the medical nature of the facility

AESTHETICS

Space and form considering palliative treatment

Sensory impressions throughout the building and gardens

Integration in the landscape

Hidden functionality when not used

Transparency and blockade to enhance the space.

Active considerations on both natural and artificial lighting in all rooms

Materiality and color should consider the children's perspective

Create homely atmosphere

Decoration as an active spatial choice

TECHNIQUE

Danish Building Regulation Energy Class 2020

Integrated passive and active strategies

Comfortable and easily adjustable indoor environment

Brine to water heatpump

Renewable electricity sources

Ventilation should prevent spreading of diseases

Comfortable acoustics

DESIGN PARAMETERS

The design parameters should be understood as a whole, where none of the parameters can be spared and all are equally important. The parameters influence each other, and the boost of one parameter will affect the rest in either a negative or positive way.

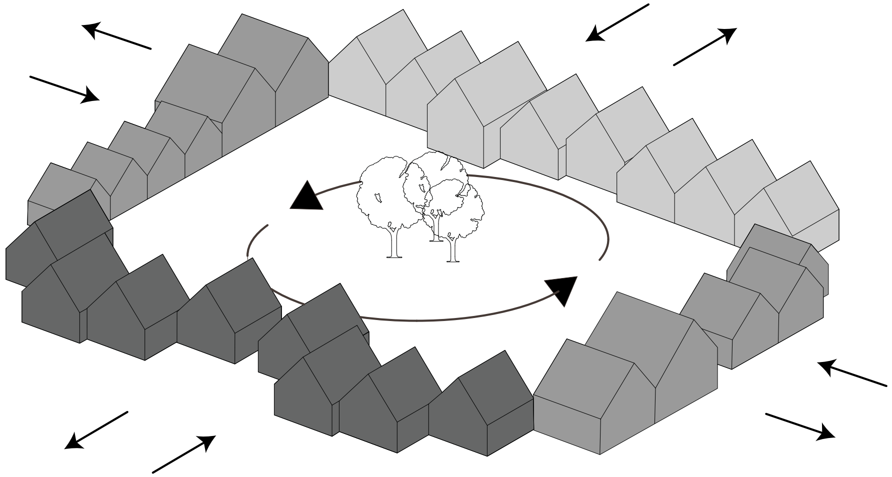
The parameters should not be understood as a checklist where all principles necessarily can be met a hounded percent. They acts as guidelines to help priorities decisions during the integrated design process.

VISION

The goal of the project will be the creation of a children hospice in Hammer Bakker. Since the first hospice opened in Denmark in 1992, there have been a large demand for their services. The idea that death should happen with dignity and without struggle and pain, has a wide appeal for both the terminal patients and their relatives. A children's hospice goes the step further and creates a building where children and their families can be relieved of both pain and stress of terminal or incurable disease.
The hospice should follow the tenants of healing architecture where the palliative needs of the patient is taken into account through the architecture.

- It should be a building where function and aesthetics go hand in hand.
- It should be accessible to all.
- It should facilitate wide array of sensory perceptions and stimulations.
- It should provide the space for palliative treatments, programmed for ease and safety.
- It should create comfort in arrival and allow for a solemn departure.
- It should be sustainable.
- The dying are still living, and dying children should be able to enjoy the remainder of their short lives painless and dignified.

ill. 067: Image of Pebermosen during may.



ill. 067: Concept diagram.

CONCEPT

To create a design that substantiates personality and give the patients and families a sense of having their own space within a secure and comfortable community. Ideas that fit with the desire of creating a safe and homely atmosphere as described in sections of both palliative and healing architecture.

Pebermosen, located I Hammer Bakker in northern Jutland, was chosen due to the beautiful scenery and palliative qualities of the site, as the vistas, calmness, birds singing and the ever changing colours of the seasons.

The project must be developed with respect for the for the landscape and it's existing users, such as people hiking, running, mountain biking etc.

The cabin is a characteristic and well know building typology that fits well within the concept of privacy and a typology that already represented several places in Hammer Bakker. Placed together in a series the cabins form a community that offers a social aspect, which is also described in both healing and palliative architecture as a positive element in order to share experiences and gain the feeling of safety.

The circular flow is chosen due to the intuitive navigation of a circular shape, which in previous sections is described as a mean of minimizing the stress associated with navigating a foreign building. The circular shape breaks down and eliminates long and straight corridors, which at times seem insuperable and uninspiring.

Placing functions along the circular flow by a gradient system spanning across public – semi public – private, helps to avoid the unnecessary disturbance for the weaker patients in need of rest. It promotes the homely atmosphere in the private section by keeping most of the work-related functions as offices, meeting rooms etc. away from the private patients units.

In order to fully utilize the qualities of the site in a respectful manner, the complex must be shaped to fit with existing contours, views of nature and the orientation of the sun. Meanwhile focusing on accessibility for the weaker patient's as well as the daily workflow.

PROCESS

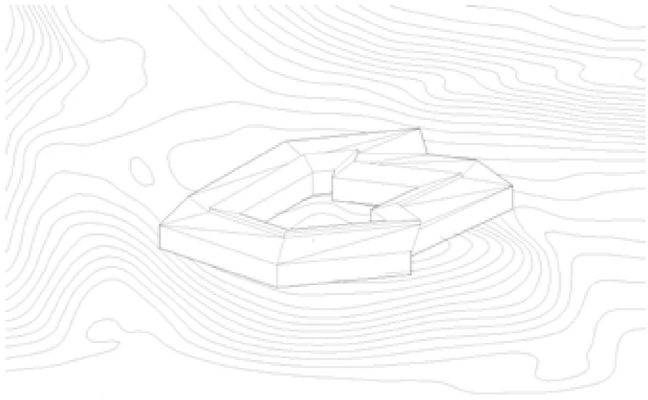
The following section describes how the design developed in relation to the IDP, concept, vision, technical considerations and research within both palliative and healing architecture described in the program.

At this stage, technical solutions regarding the use of a vertical brine to water system for floor heating, was already chosen due to the lack of connection to the main grid. The need for energy from photovoltaic cells, was clear from an early stage. It called for considerations on the orientation of the complex, according to the path of the sun, as well as clearing and placement of trees. Regarding the ventilation a facade integrated system called inventilate was chosen, due to low energy usage and it's architectural freedom.

The design went through three parallel directions regarding the site, placement of functions and orientation, in order to rea ch a design that would fit as many parameters as possible.

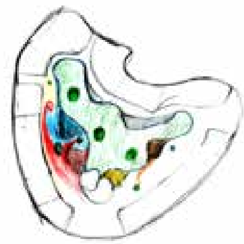
Due to the complexity of designing a children's hospice, several prototypes of certain functions was created during this stage, to add a senses of scale to the preliminary designs.

The result of these studies led to a design that was brought into the syntheses phase for further development.



ill. 068: Flow with pitched roof

ill. 069: Organic volume that show an organic flow trying to imitate the site.



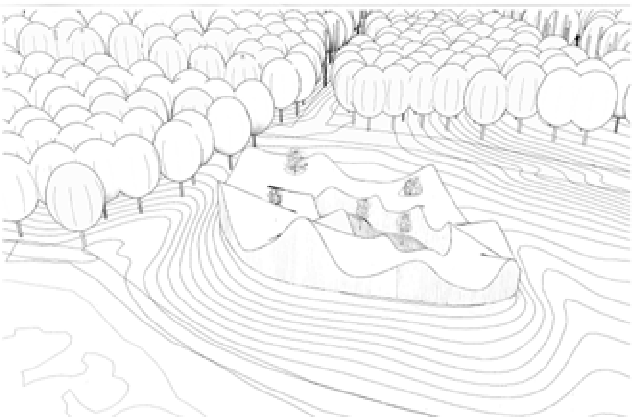
ill. 070: Organic volume with flow joining into functions

VOLUME STUDIES - SITE

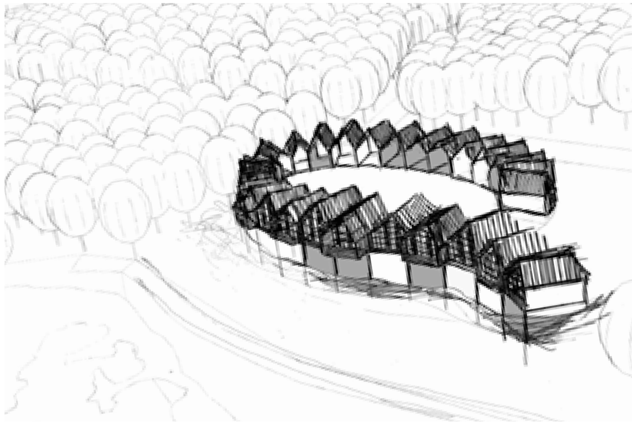
The site was chosen for its natural beauty, the project should strive to mimic this and minimize interference on the site.
This is thesis for the site approach. This leads to designs that sacrifice functionality for a natural expression or tries to place the building in a way that plays into the surroundings.
In the early process, this surmounted to designs that were very organic and flowing in nature. In early sketches the idea that the interior should reflect the exterior, and thereby feed into the children's imaginations. The wobbly lines would be accompanied by bright colors signifying how functions feed into the hallways. The weaknesses of these designs were manifold. While they may be an exciting novelty, they would not naturally offer the calm predictability the palliative patients need. The designs while trying hard, would either not fit onto the site or not be able to contain the required functions.
Further developments lead the iterations into stringent interpretations of how to fit the building volume onto the site. This lead to a split in the design, either fitting the plan to the contours in the landscape or creating a geometrical plan that tries to fit around the hilly site.
Volumes following the elevations had several major problems. One not being able to contain the functions in a meaningful fashion, if the purpose of this design were to build on the site with no interference then the building would have to be severely constrained in its span. While it may look very fitting in the plan following the elevation curves might not make much sense in reality. Construction would undoubtedly interfere with the elevations so inference would happen to some degree anyway.

Building a buried structure was quickly dismissed for plenty of reasons. Light would be exclusively from skylights, ventilation and indoor climate would be more problematic to handle. Finally, it would not be an inviting place for children, and the connotations to being buried were a bit too rough.

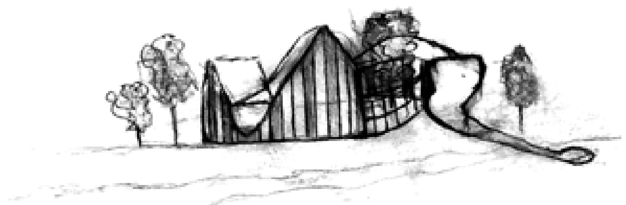
The process edged towards something that loosened from the existing site as it is, but towards designing something that would give back to the site and interact actively with it. Using the qualities of the site to give something to the building, while making the building interact naturally and expectedly with the surroundings. Therefore the final designs would both provide a nice environment for the inhabitants, while creating public facilities and taking the public use of the site into consideration. Rather than abstractly fitting the plan to elevations, the volume and material use would define the contextual interaction.



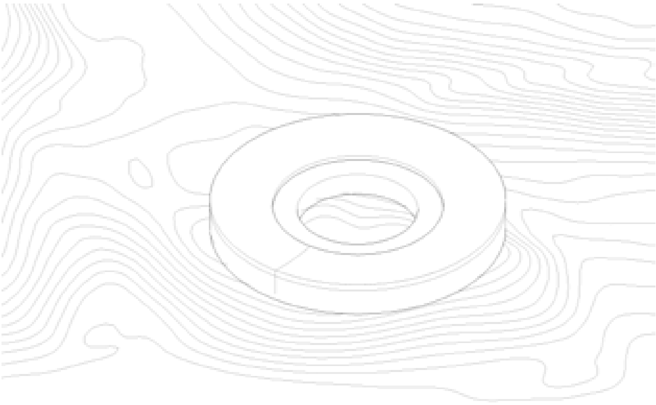
ill. 071:Volume following the contours of the lanscape, roof imitates the hills



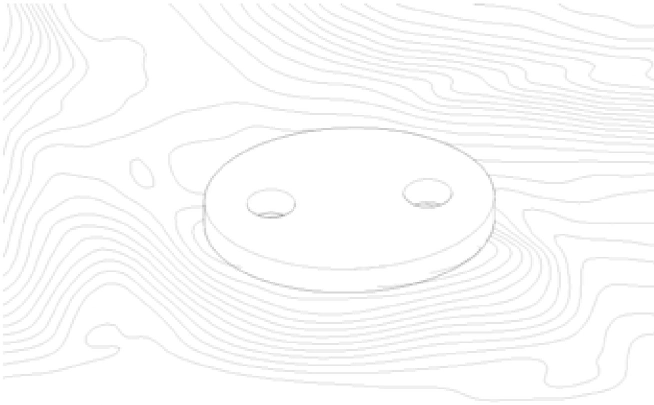
ill. 072: Spiraled flow of pitched cabin raised above the site



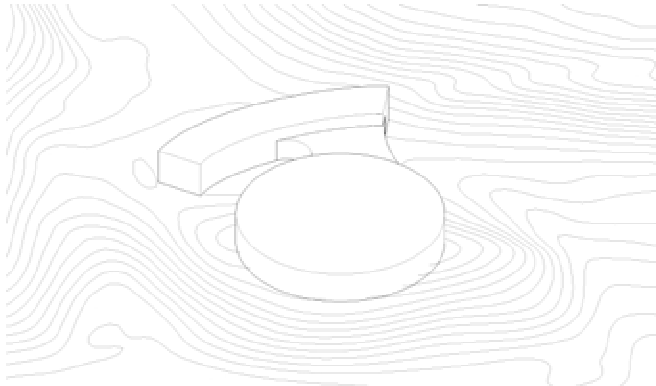
ill. 073: Volume grabbing onto the lanscape and raises itself in a curved contour.



ill. 074: Circle volume that ephasizes an interior circular flow around a courtyard



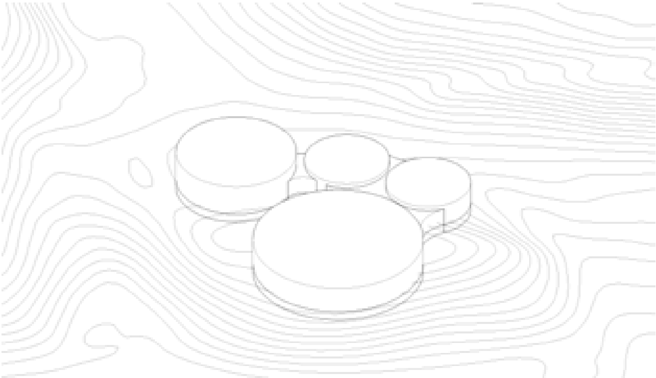
ill. 075: Circle volume that ephasizes an interior circular flow around two smaller courtyards



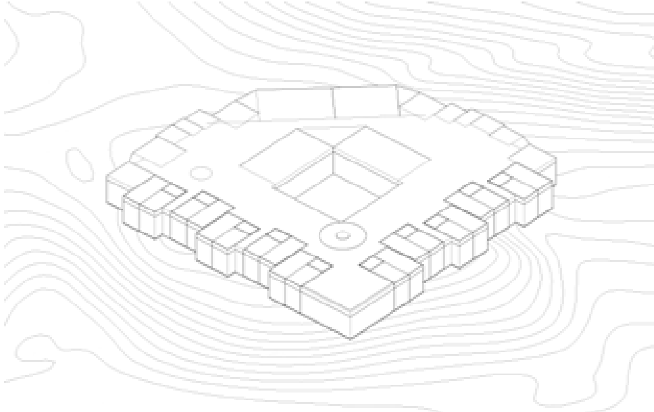
ill. 076: Volume divided in two seperate functions between private and puplic

VOLUME STUDIES - FUNCTION

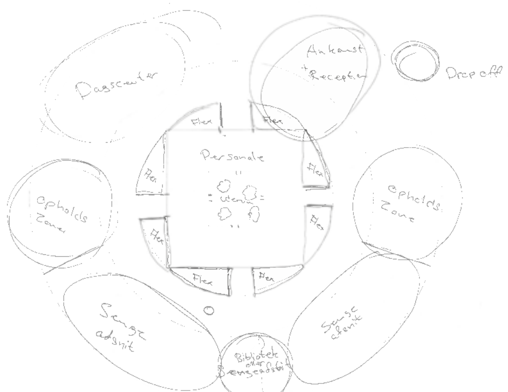
This direction run very counter to the site. Where working from the site had a very exterior perspective, working around the functions were the interior. This direction focused almost exclusively on the program and concept as its point of entry.
It is obvious in the early volume studies, these were three dimensional concept diagrams placed onto the site. The circular flow is inserted and reinterpreted in different variations, the interior garden moves, splits or is moved outside the volume in a looser interpretation of interiority. The functionality were mostly considered from overall calculations of the functional areas. This did not consider extra areas like hallway, and the usability of the spaces.
A major snag in the process came from the fact that the building program is incredibly complex with many functions tying into one another. As the process developed, it became clear that it was impossible to comprehend the plan structure without sketching out the functions with individual areas to start considering the actual interaction between them. The process moved into a phase where only very loose simple geometries would determine a pattern for the placement of functions.
Several concepts like placing watch rooms and common rooms close by the patient units, and the staff functions in its own enclave were upheld. A major step in the functional direction were the abandonment of the idea that all patient units would need some kind of view to the lake. The common room would contain that function. Slowly the process moved into a square shape superimposed by a circle.
Working completely inside out following the concept and program slavishly, a plan started to take shape. The interior garden would be a square surrounded by an interior ring of functions that would also serve as the flow contour. The flow would follow the ring unhindered creating an easy and comprehensible navigation around the building. The circular flow would likewise be a great way of distributing ventilation ducts. Therefore the functions that needed larger volumes of airflow than what inventilate could provide, would be placed along the interior flow. A large hallway space flowed into the different functions along the outer ring of the building. Using smaller interior gardens sections, these flows would be steered and the views would be blocked and filtered creating levels of privacy, and small groupings in the patient units.
The plan were optimized and spatially and functionally. But had two major problems. It would difficult to create a unified roof construction. But much worse, the building would not fit onto the site no matter what. It could function but simply not on the given site. Meaning that the process had to move into the exterior again.



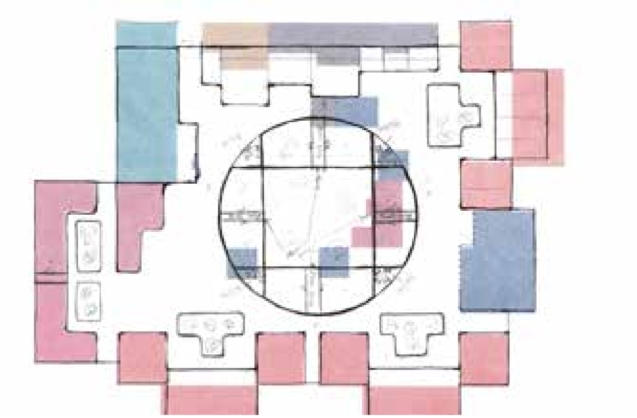
ill. 077: Volume divided in four seperate flows containing different functions



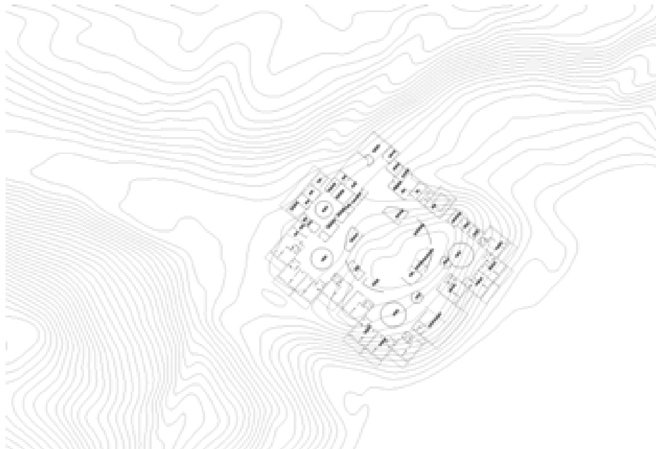
ill. 078: Common room pointing towards the lake with patients unit placed along the sides.



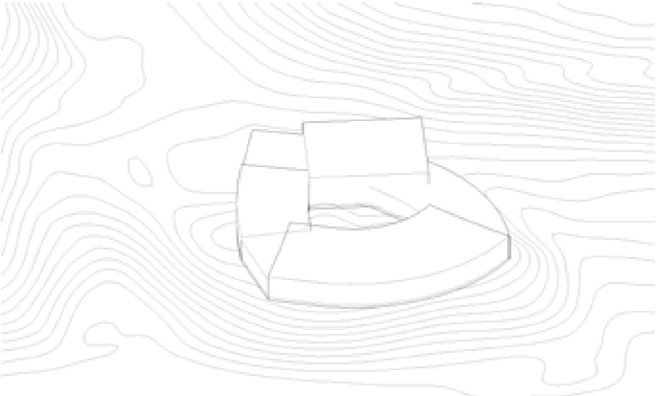
ill. 079: Sketch showing the distribution of function in simple geometries



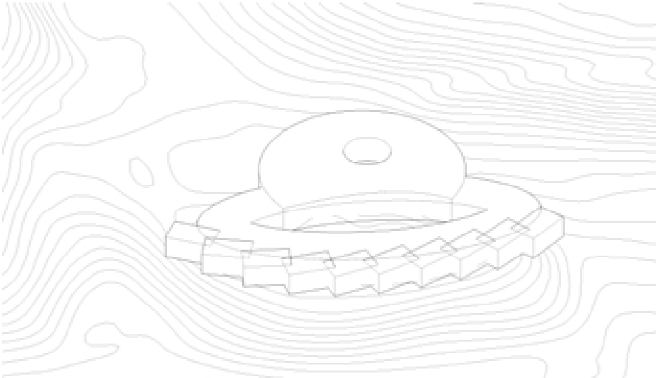
ill. 080: Circular flow within a retangular shape



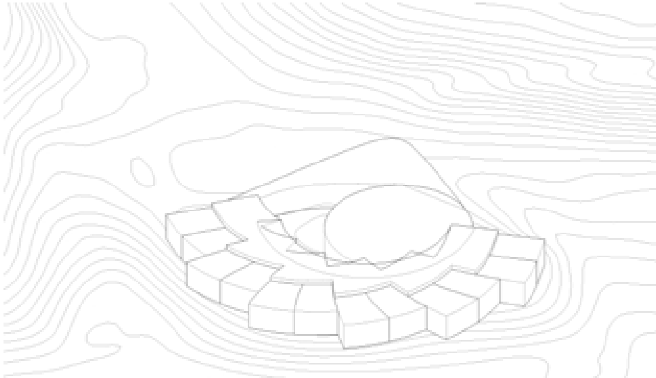
ill. 081: Development of a retangular showing the functions flowing into hallway. Units are placed in clusters around interior gardens.



ill. 082: Early concept showing concept based on view and daylight



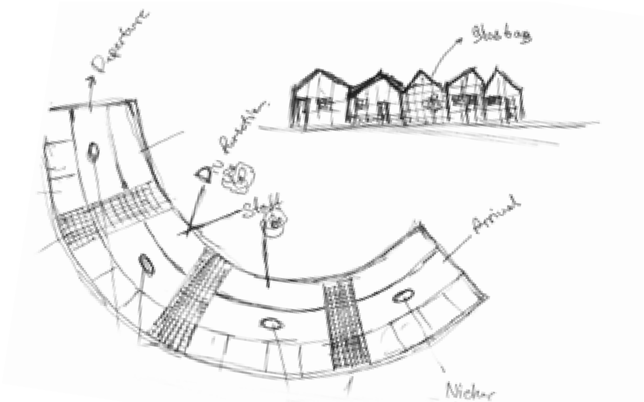
ill. 083: Volume showing row of patient units facing the lake and flowing into the remaining functions place in a singular mass



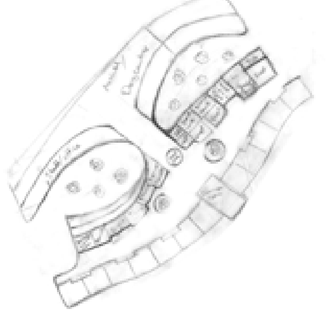
ill. 084: Volume showing row of patient units facing the lake similar to ill. 83, but with the patient units in pairs.

VOLUME STUDIES - ORIENTATION

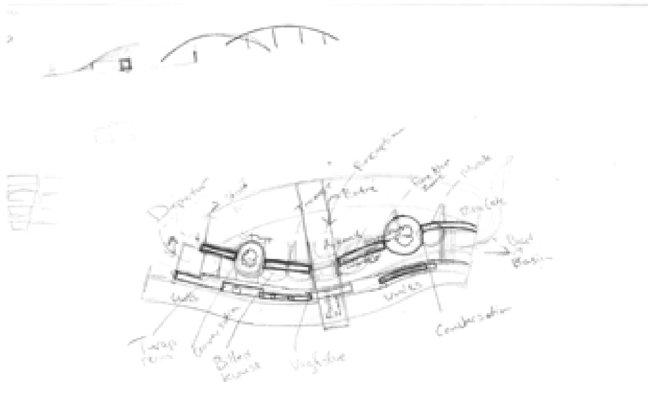
Orientation were another major steering concept for a large part of the process. While it certainly is important in most architectural projects, this is meant to be understood not so much in way of daylight, since this was a major factor in all iterations, but more in the sense of orientating the functions towards certain views or considering the usage of the surrounding site to gain privacy.
The early volumes focus almost blindly on orientating the patient units towards the lake. The main parameters taken into consideration were the view and the fact that the units should not interfere with one another. Orienting the units towards the lake also had the side effect of orienting them to the east-southeast, avoiding the overheating potential towards the south.
Early on, it became apparent that it would be impossible to fit all units into the same orientation; they simply made up too large a part of the volume. Therefore, the development moved in the direction of crescent shape. The circular flow around the building would happen by either connecting the crescent into a larger central support structure housing staff and treatment facilities.
The other concept were the tiered crescent, where units oriented towards the lake shared hallway with a band of treatment facilities and common rooms. Interior gardens would ensure daylighting in both hallways and the therapy rooms. The next crescent would consist of staff, arrival and day center functions. Smaller circular flows would happen around sections defined by perpendicular axis hallways. The hallways would also provide views through the entire building.
The problem with all orientation studies were fitting the units onto the site. Often one or two units would not have any view to the lake, which was a major problem when the entire design revolved around this.
Later iterations moved into solving the problem by placing the patient unit along a ridge in the landscape. This would maximize the view towards the lake and create a similar microclimate around each unit. Connecting through the building would be a central axis. The axis begins in the arrival and terminates in the common room with a magnificent view over the lake. At either side of the central hall interior gardens and therapy functions would create blocks that the flow could circulate around.
The problem is that type of unit would be a either a very contrived flow moving back into itself, or long hallways in a T-plan. If the T-plan were the chosen solution long corridors that couldn't naturally draw sunlight in through the sides would end blind, stopping the flow dead and creating outlier units. This would go against the concept and knowledge gathered at this point in time.



ill. 085: Crescent shape with three layers of functions

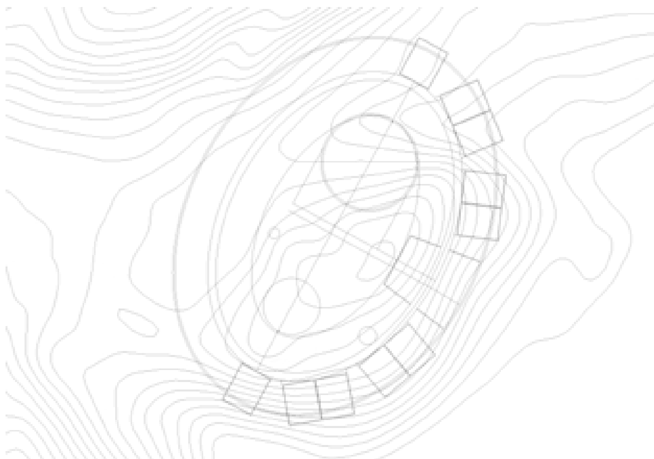


ill. 086: Unit placed along ridges with a T-axis



ill. 087: Unit placed along ridges with a T-axis

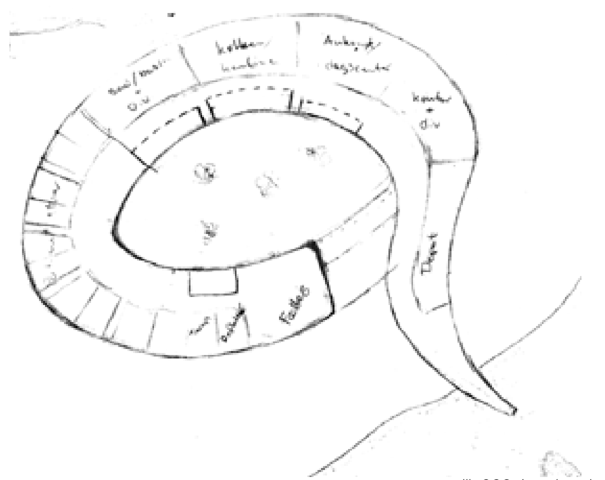
ill. 088: An elipse volume with units facing the lake and central axis



ill. 089: An elipse volume with units facing the lake and central axis

ill. 090: Functional iteration

ill. 091: Iteration based on orientation



ill. 092: Iteration site

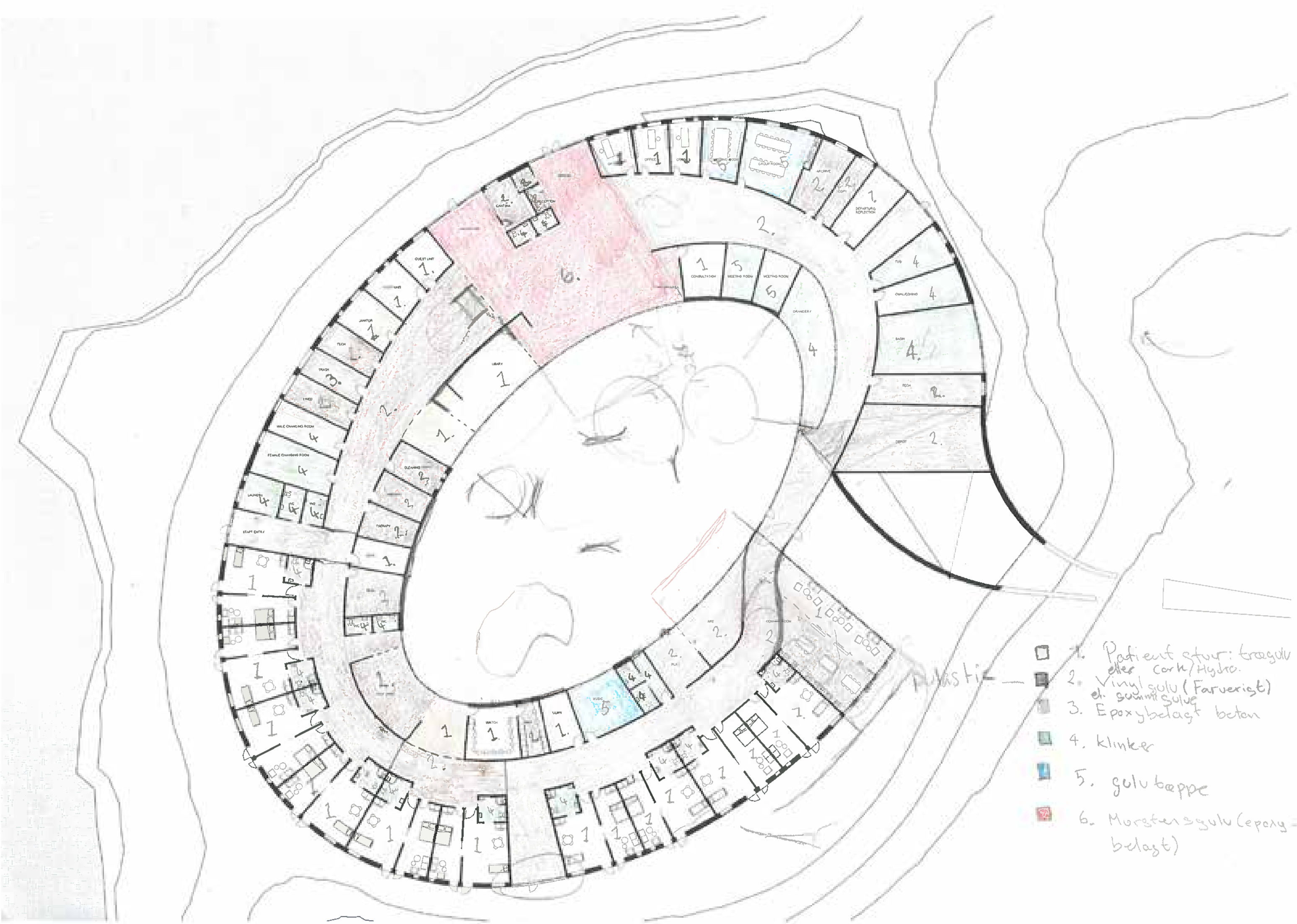
FURTHER DEVELOPMENT

Each of the three directions described in the previous pages culminated in designs that more or less embodied a logical conclusion to each approach in the context of this project. Some of the design were further in the process than others.
The functional approach were developed and close to enter the synthesis process, but not fitting the chosen site were considered a fatal flaw. Other problems would most likely have arisen from the somewhat undefined spaces that composed the hallway.
Nevertheless, approaching the project from a pure functional perspective were absolutely necessary to actually realize a plan that would come together and work. The composition of functions worked. Splitting them into two rings. An exterior turning to the surrounding site, thereby gaining privacy from the remaining building and views into nature, and an interior turning to the inside of the building socializing and turning to a safe interior garden. The two rings defining the flow around the building where a central hallway that flows into the different open functions.
The approach from orientation, were in many ways the least functional but a worthwhile experiment in flow and placement. The experiments showed that it would be impossible to orientate all units to towards the lake without making major concessions to both site, functionality and flow.
It did create strategies for partitioning the plan into smaller sections by creating perpendicular cuts and axes. It were considered worthwhile to create views through the building from the arrival, presenting the building in a picturesque vista. This could also create views where the inhabitants easily could orient themselves in relation to the entire volume.

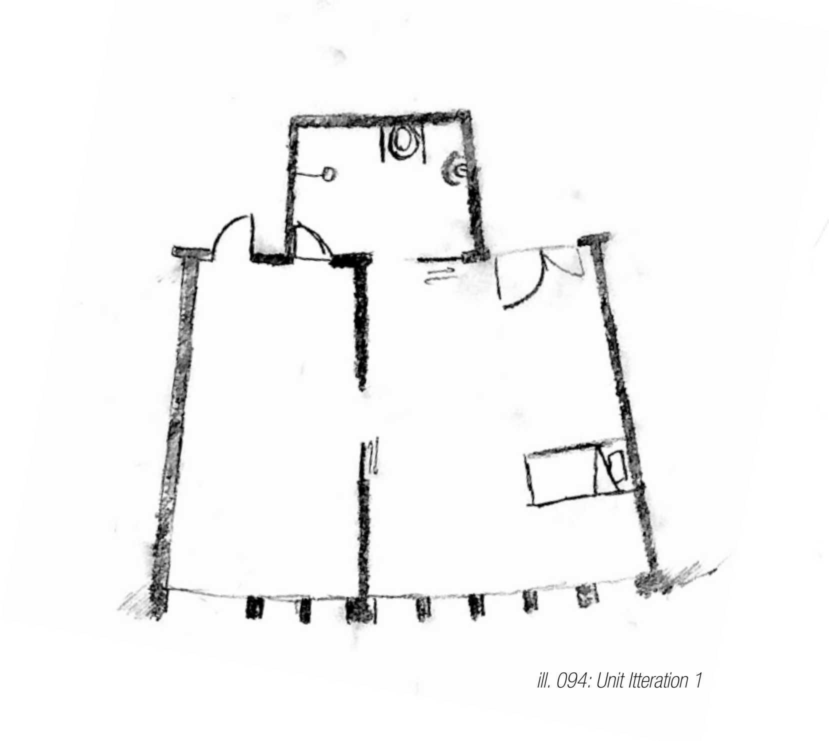
Approaching the building from the outside and in with respect to the site revealed how difficult it is to fit a building into a curving site like this. The orientation of the building were also rather given regarding access roads and daylight. Working from the exterior were impossible in a complex project like a hospice, one can't just consider a gross volume. Therefore, most of the early iterations were failures in containing the building functions.
The site approach were redeemed once a deeper understanding of the project were achieved. Understanding that the approach to the site would be to interact with the expectations and perceptions of buildings in nature. Working with the volume as something that would grab into the landscape and blend with the forest, but still a volume that were obviously made by human hand.

By combining the positive feature of the design direction, an iteration encompassing both consideration of site, functionality and orientation were created.
The patient units were not oriented towards the lake necessarily, rather the common room. Interior gardens and axes through the building are mainly oriented in this direction. The patient units still get views into the forest. On the sideline, façade and daylight solutions have been developed to handle the solar radiation from the south.

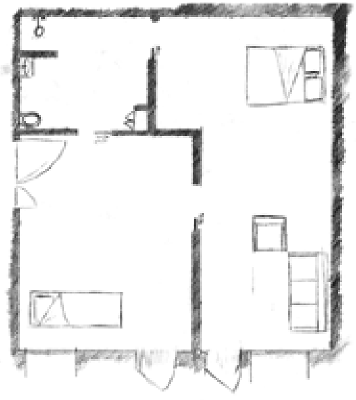
The functions are placed in two bands, that moves along a snakelike body walling in the interior garden and terminating in a tail that reaches down in the landscape, down the hill and into the lake creating a public bridge knitting the building into the existing paths. All functions are placed with the knowledge gained in the studies related to function. The hallway is still wide but the functional flow doesn't dissolve into undefined spaces, it is directed into very specific sections with perpendicular hallways or interior gardens partitioning the volume.
This sketch were carried into the synthesis.



ill. 093: Combined volume chosen for further development



ill. 094: Unit Itteration 1



ill. 095: Unit Itteration 2

PATIENT UNIT DEVELOPMENT

Parameters was set before initiating the design process for the patient units. The unit was set to approximately 60 m2 according to the program, and needed to fulfil certain criteria within accessibility for bedridden patients and patient in wheelchair. Doors should have a minimum width of 1070 mm, while turning radius in the bathroom have a minimum requirements off 2000mm. The same turning radius is required from one side of the bed to the wall. Beds measures 1000*2200mm and needs free space of 750mm to the side and 900mm from the end of the bed to the wall.
To help bedridden patients a lift should be installed in the ceiling, leading from the bed to the bathroom in a straight line while keeping the track plane. Slits should be made in the wall over the bathroom door to allow for access. A number of demands are set for designing units in care facilities, and in this case the guide issued by, the department for Senior Citizens and Disabled in Aalborg municipality, was used.

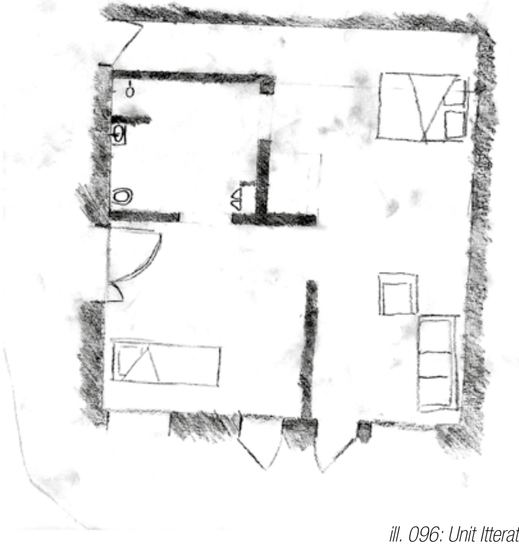
Besides demands regarding accessibility, criteria's was developed after analysing an interview with chief of development at Sankt Lukas children's hospice, Signe Hörluck, and the research made into healing and palliative architecture, described in the program.

The units should facilitate room for both the patient and the relatives, the comfort of the relatives influence the level of their involvement in the daily care in a positive manner.
The unit should be designed according to the view spectre of a bedridden patient, regarding both view of nature and elements as electronic entertainment and art etc. in general.

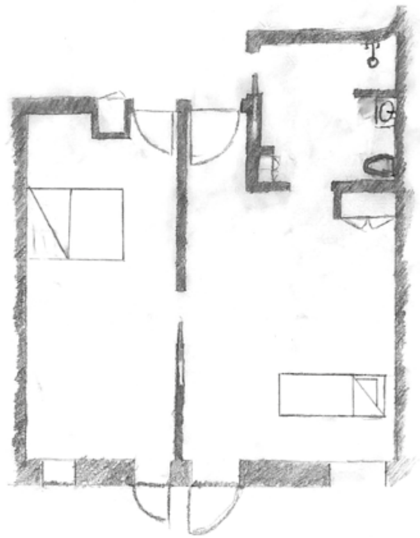
The design process of the patient unit, is being conducted parallel to the design studies relating to site, placement of functions and orientation.

Iteration 1.
In this solution the placement of the bathroom isn't optimal according to the piping. None of the bathrooms share any plumping with another bathroom making it an expensive solution. The placement of the bathroom also divides the niches in front of the units. Meaning the relatives of a unit share an entrance niche with the neighbouring patient instead of their own family.

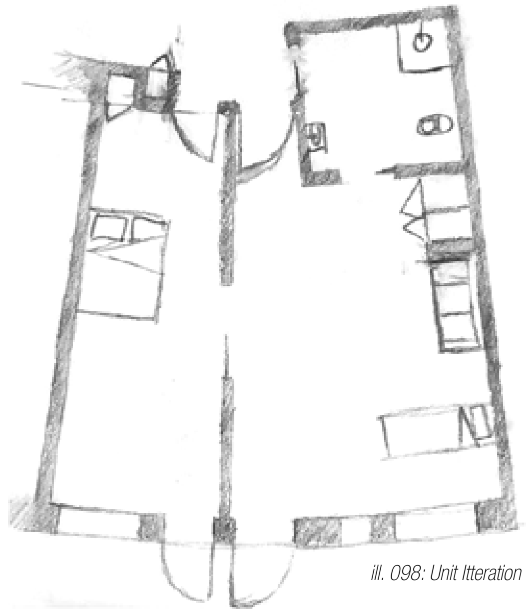
Iteration 2.
This design originates from a plan where the units where placed in clusters of four units with a closed corridor surrounding a small common garden in the middle. This unit doesn't contain the option of a having two separate doors to enter either the patient room or the room for the relatives. Meaning the relatives lack the option of coming and going without the possibility of disturbing the patient unnecessarily.



ill. 096: Unit Itteration 3



ill. 097: Unit Itteration 4

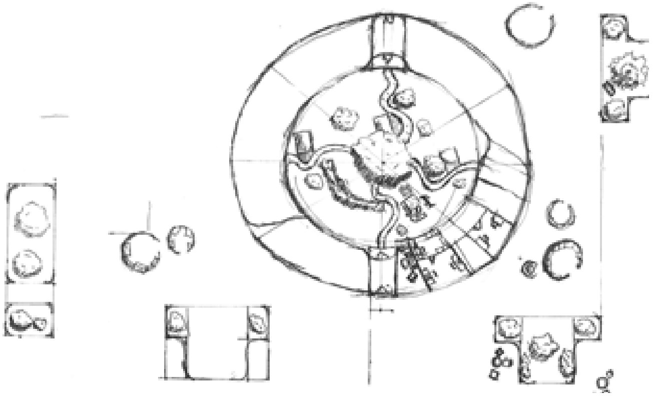


ill. 098: Unit Itteration 5

Iteration 3.
In relation to iteration number 2, a second door is added allowing the relatives to access without disturbing the patient. This results in a rather dark and narrow entrance corridor for the relatives, while at the same time compressing the patient unit making it difficult to fit in the necessary furnishing.

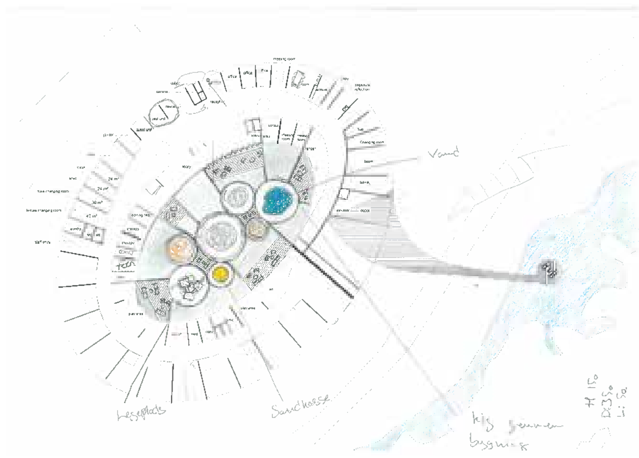
Ite
Still fitted for a cluster containing four units and common garden, this unit allows for separate access for patient and relatives to both unit and bathroom. The placement of the bathroom allows for the families to have their own entrance niches, but the placement is not optimal according to piping.

Iteration 5.
Iteration 4 fitted into a circular shape instead of the cluster formation. Still allows for separate entrance, and families to have their unit related niches, while also letting bathrooms share their piping in pairs of two. This this also take the modern family structure into consideration by allowing for the neighbouring relative room to be utilized by divorced families.



ill. 099: Interior garden that mimics the exterior contained in a geometric shape

ill. 100: Interior garden connecting functions where the concept is more controlled.

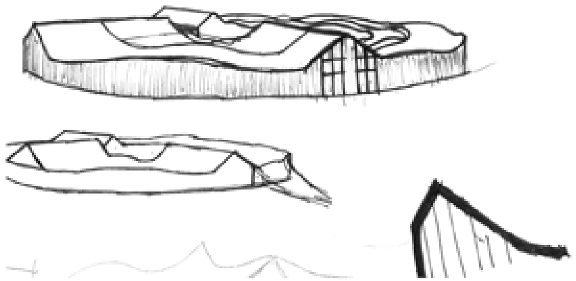


ill. 101: Interior garden using circles and tagents for compositions

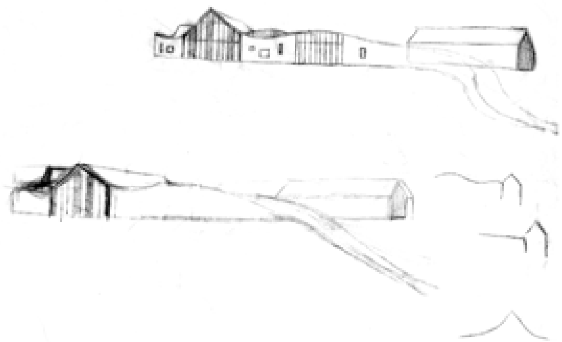
INTERIOR GARDEN

Sense gardens have become a staple in hospices and a cornerstone of palliative treatment. In the gardens a variety of flowers, herbs and plants creates a symphony of smells, color and movement. Honeybees buzzing and butterflies fluttering among the flowers.
As plan and volume were explored, the interior gardens were outlined. Since the garden would both define and be defined by the building volume, the concept for the garden would be paramount during process.
The concept of the garden developed from the idea that it should mirror the area around it, to visualize a building that settled into the landscape without disturbing it. The garden would act as a sheltered piece of nature within building volume that the patients could enjoy without being subjected to impassable terrain and harsh weather. Paths would lead through the garden and connect the different areas with one another. The garden would be confined within a strict geometric shape, either a circle or square contrasting the lush nature within.
Along the designprocess as the final volume started to come into fruition. The concept of the garden started to change, rather than imitating the exterior, the interior garden would be more cultured and controlled within its geometrical confines.
In the end the concept of the cultured garden were completely embraced. The interior garden is sheltered and artificial and functions as an alternative to the surrounding site. This was empowered by the decision to pave the paths around the site and controlling their slope for accessibility. Circles and circle tangents creating high beds for plants with low maintenance these zones allow different levels of privacy and different kinds of activities.

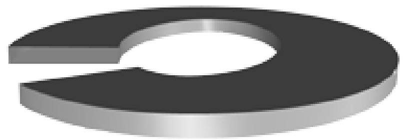
ill. 102: Pebermosen



ill. 103 different roof sketches



ill. 104: different roof sketches



ill. 105: Iteration 1

ROOF DESIGN

Designing the roof required the consideration of several interlocked parameters. The final design reflect a balance of these parameters achieved from a long series of iterations.

The roof serves an array of functions. These range from technical solutions to aesthetic impressions.

Shaping the roof is a procedure that should consider the exterior form and the interior space. The roof edges serve as contours that either blends with or contrast the forested surroundings. Since the building is planar the roof will be defining the overall shape of the building as perceived from the outside.

Since the site has plenty of elevated points, the roof can be observed beyond the normal pedestrian point of view. Therefore the form should be pleasing from both an elevated and lowered perspective.

Spatiality and light were the main consideration for the interior. The patient units need a homely and calm atmosphere with plenty of daylight (Nissen et al., 2008). In the hallways, the roof should allow light to enter the hallways, while engaging the winding flow throughout the building. In the interior garden, the roof should not shadow unnecessary, and create a pleasant enclosure.

It is essential that the roof is angled and sloped, to reach the necessary electrical output from PVs to cover the requirements calculated in be15.

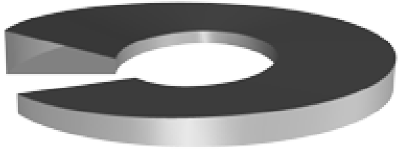
The structural solutions should not intervene with the previous parameters and be able to handle the forces generated by the chosen solution. The roof should be able to handle snow and an increasing rainfall as a result of of climatic change.

All roof structures were generated parametrically; this allowed the choice to be based on iterative feedback. All roof types were extensively customizable, with some base characteristics defining the different solutions. As the choices narrowed down, further testing parameters were introduced.

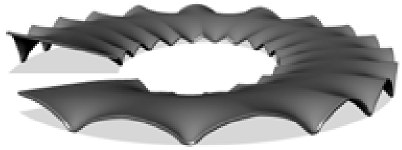
Once the final design system were chosen, an evolutionary solver were used to optimize the roof in regards to solar radiation.

Iteration 1: Flat roof

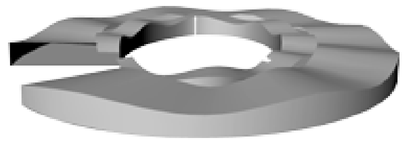
A flat roof, sloping slightly to shed rainwater. The building gains a horizontal contour in stark contrast to the woods. The curving shape blurs, the only signifiers are the windows and cladding. The interior space is very institutional. PVs need to be angled on top of the roof, and cannot be integrated. Functions are indistinguishable from the outside, and functionality will be harder to differentiate on the inside.



ill. 106: Iteration 2



ill. 107: Iteration 3



ill. 108: Iteration 4

Iteration 2: Rising and sloping inwards

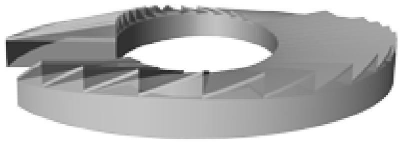
The elevating roof gives a sense of direction on the inside. The elevation does not take into account the interior functions, often creating wildly inappropriate dimensions, for instance the patient units would have very tall ceilings while basin and arrival would be low. If the elevation is reversed the tallest room would be technical room and connection to the tail would be steep. The solution would be adaptable to solar cells, but not optimizable since the steepest slope would never be towards south. The contour would be hard to read from the outside since the slope would have a low angle along the entire length of the building, therefore maintaining the horizontal orientation of the flat roof. Structure would be solved by a frame construction.

Iteration 3: Shell Structure

Encapsulate each function by placing geometric attractor points at each dividing wall. Creates natural openings, the structure and aesthetic are unified. The shell structure are inherently strong and very modifiable. The interior space would be defined by the structure. Indoor and acoustical climate would likely be problematic and needed major concessions to work. The building contour are flowing and dissolved, the openings and joining curves create a vertical movement, albeit not particular strong. PVs can be incorporated as cells in the shell structure but larger efficient arrays are not feasible, since they would be impossible to gain identical solar radiation in larger areas.

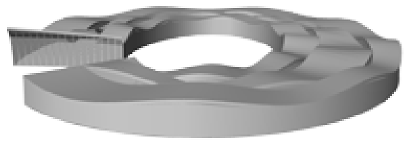
teration 4: Two Waves

Two synchronized waves with opposite amplitudes split the volume, the space between the openings create natural entrances for light. The split can be placed where deemed fit. Although with the protruding toilet cores by the patient units and the lowered ceiling by their entrance the light would not be utilized well. Therefore the ideal placement would be in the split between the hallway and the interior ring of functions. The roof does not consider the interior functions, creating rooms that have more or less desirable traits at random. Acoustics could be problematic since the lower point in the wave is the diffusing while the top is focusing, therefore all functions caught in the focus would have large acoustic problems. The contour of the building is elegant in its subtle weaving; it speaks more to the hills and the water than the forest. The form is very different from anything else in the area, and uses a less recognizable form language. The roof is well suited for PVs, the differentiated slopes and directions means PVs can be placed and orientated to utilize light at different times of the day and the year.



ill. 109: Iteration 5

ill. 110: Iteration 5 solar analysis from 100 to 1200 kW/h m²



ill. 111: Iteration 6

Iteration 5: Scales

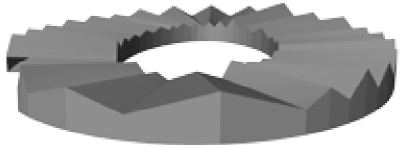
The scales are optimized to open towards the north pulling in the diffuse northern light through slits between the scales. Therefore, the scales also angle towards the south optimizing placement for photovoltaics. The scales can be fitted to respect interior functions. The interior space would be bright and dynamic because of the angled ceiling and serial openings. Elevations could be varied over the length of the building to fit the expressions and interior space.

The contour is very sharp but undefined, the scales would not be comprehensible from the human scale and would be perceived as a sea of spikes. The form would be very noisy in the landscape and not compliment it. The solution would properly fit on a different site, but the noisy expression may be unfit for a children's hospice.

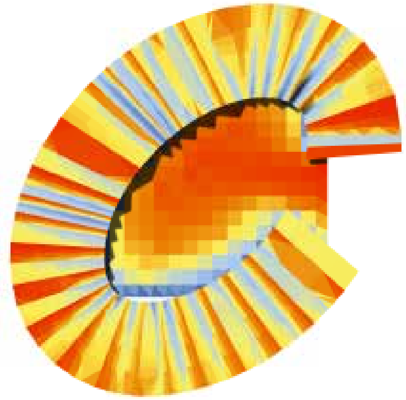
Iteration 6: Three Waves

This iteration is very similar to the two waves, with three waves following the internal flow. It has a lot of the same traits and problems as the previous iteration. The idea of splitting the flow in three would mean light could enter all rooms from two sides. The contour and expressions would be identical to the two waves but the interior would be split in three different flows and allow more light. An iteration of the roof were made following the internal functions. The results was an aggressive and messy expression that placed an acoustically focusing ceiling on each function making it unviable. The three waves have a major problem with handling rainwater, since the two outer roofs box in the lowest points in the middle roof. Staggering the three roofs' flow instead would eliminate the problem but remove most of the glass openings for light. Internal drainage was considered too risky because of the wooden construction.

ill. 112: Iteration 6 solar analysis from 100 to 1200 kW/h m²



ill. 113: Iteration 7

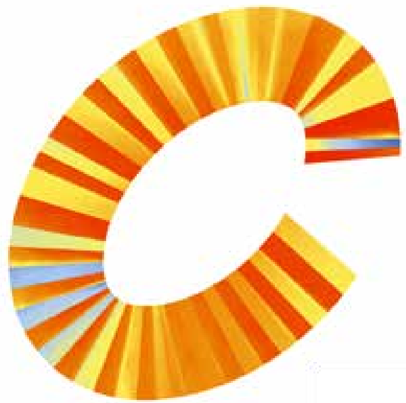


ill. 114: Iteration 7 solar analysis from 100 to 1200 kW/h m²

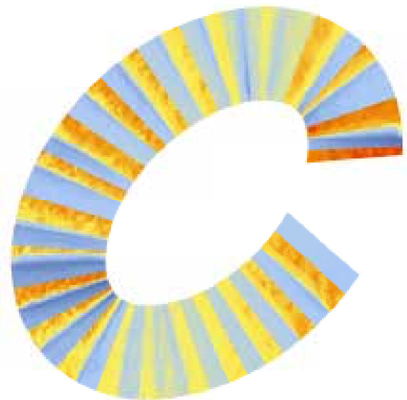
Iteration 7: Gable Roofs

The gable roofs are a recognizable shape, mimicing the contour of a house or a cabin, which tradionally is nordic. The building gains the expression of an interconnected chain of cabins, each defining functions on both the interior and exterior. The roofs are not necessarily the best choice with regard to PVs, since the pitches tend to shade for one another, but it is not impossible to solve and just requires fine-tuning. Indoor climate depends on the pitch and placement of windows. In this solution the gable roof will have to consist of double curved surfaces because the edges defining each segment are non-parallel. Acoustically the roof surfaces will act as slight diffusers. The contour of the building are vertical, this blends well with lines of the trees. Snow and rain will need to be lead along valley gutters between each roof segment, and the construction will have to bear heavier snow buildups in the gutter.

ill. 115: *Optimized solar analysis from 100 to 1200 kW/h m²*



ill. 116: *Optimized solar analysis from 250 to 950 kW/h m² from March to october with foilage on the trees*



ill. 117: *Optimized solar analysis from 20 to 125 kW/h m², from october to march without foilage on the trees*

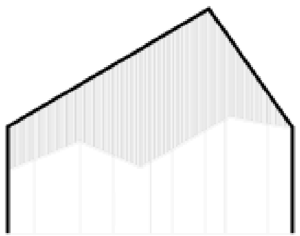
PLACEMENT OF PHOTOVOLTAICS

Roof surfaces has been optimized to the placement of PVs. A wildcard in this equation is vegetation. The aim of the project is to create a building within nature, therefore vegetation should not be removed unnecessarily. The remaining trees are old and tall, it is inevitable that they will shade the building. Final solar analysis for the model utilized primitive trees to simulate the forest. Analysis were done for the period March to October with foliage and November to February without.

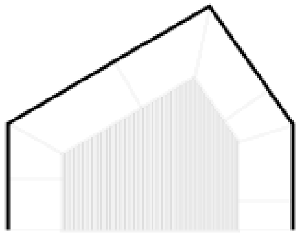
The conclusion of the analysis would be to place the Pvs on the roof surfaces on the eastern and southeastern part of the building. These are facing the lake to the east and south with the internal garden to the west or northwest.

The western part of the building have plenty of surfaces facing south but are engulfed in the forest and will receive too much shading to be viable.

ill. 118: Tree from pebermosen



Ill. 119: Iteration 1



Ill. 120: Iteration 2

Ill. 121 Iteration 3

Ill. 122 Iteration 4

Ill. 123 Iteration 5

FACADES

With a part of the concept being integration into the surrounding landscape, the facade expression is important, with different material combinations and compositions. To complement the site, mainly materials such as wood and brick should be used for cladding. The verticality of the trees should be complemented in the facade. Daylight is a key factor tied directly to the mental and physical health of users, therefore it is key to optimize the daylight entering the façade while also minimizing the overheating issue that may occur. With the project being a childrens hospice, it is important to take the bedridden children's point of view, and focus views on the nearby nature while also playing with light and shadows.

Iteration 1

The wood battens complete the vertically of the nearby trees.The large windows secures a view of the surrounding nature and high amount of daylight inside, but exposes the patients to passersbys in the area and can inflict excessive overheating issue.

Iteration 2

Again, the wooden battens complements the nearby trees, but the large windows placed around the perimeter of the silhouette does not allow the patient or relative to experience the view as much as iteration 1 and would create dark zones in the middle of the room. Natural ventilation can be an issue with non-regular windows.

Iteration 3

The use of wood complements the forest, while the rectangular windows and glazed doors create different vistas of the nature while also creating spots for sitting either on the outside or inside. The large windows gives a high amount of daylight but doesn't add any playfulness to exterior or interior.

Itteration 4

Using brick as building material gives the building a heavy expression, that combined with wood references old building methods. Where the wood gives a minor vertical expression the brick enforces a horizontality expression that heavily contrast the verticality of the nearby trees. Maintaining the rectangular windows from iteration 3 secures both daylight and a view towards nature, and creates windows niches.

Iteration 5

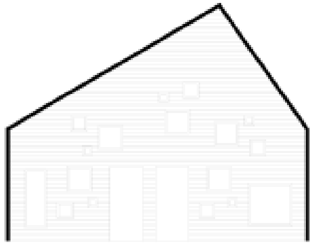
Developing itteration 5 more windows of different sizes are added and wooden battens are added to integrate the building with the environment. The expression becomes obscured as the combination with the windows, battens and bricks adds high amount of complexity, which becomes biased between a vertical and horizontal expression.

Iteration 6

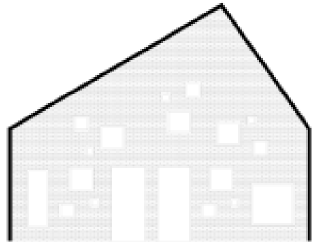
Scaling the windows to align with each other and the doors create a clear order that is easily readable, which is further emphasized by the horizontal brick. The asymmetrical window placed above the doors obscures the expression.

Ill. 124 Iteration 6

Ill. 125 Iteration 7



Ill. 126 Iteration 8



Ill. 127 Iteration 9

Ill. 128 Iteration 10

Itteration 7

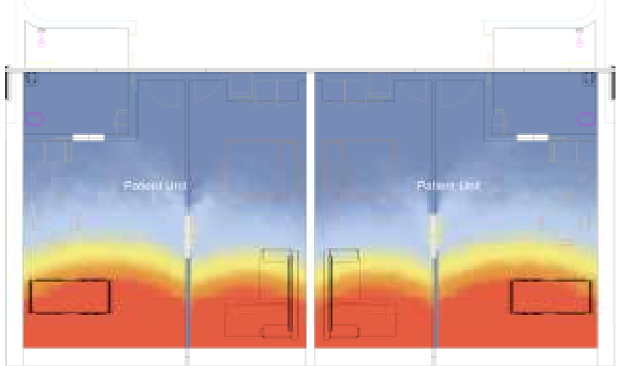
Further development on iteration 6 the windows are scaled to fit the horizontal expression. It creates an easily readable expression that has a calmness over it. Daylight on the other hand is lessened and the size of the windows can cause overheating issues, but the window placement loses the playfulness of the façade.

Itteration 8,9,10

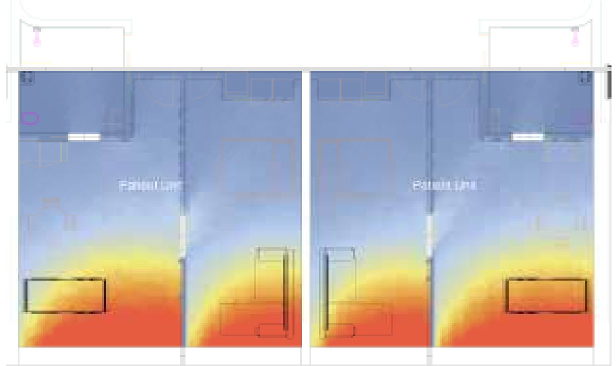
These iterations all explores the playfulness of the placement of smaller windows with two main windows for the patient and relative room of the patient unit. The asymmetrical windows of different sizes creates a play with light and shadows as illustrated on the coming pages. This also create smaller vistas for the patient to explore. Exploration is a key parameter for children as it adds a sense of adventure, which add mental and physical development. (Dudek, 2005) Itteration 8 explores the combination of the windows with horizontal batten that contrast the nature, the same thing applies on iteration 9 where brick is used, but gives a heavy expression that contrasts the environment. Iteration 10 with vertically placed wood lamellas complement the nearby trees and complements the building shape.

Test of the daylight for facade iteration 1 shows that the daylight nearly illuminates the whole patient unit, but it comes at the cost of high amounts of solar radiation that cause overheating as seen on illustration ??

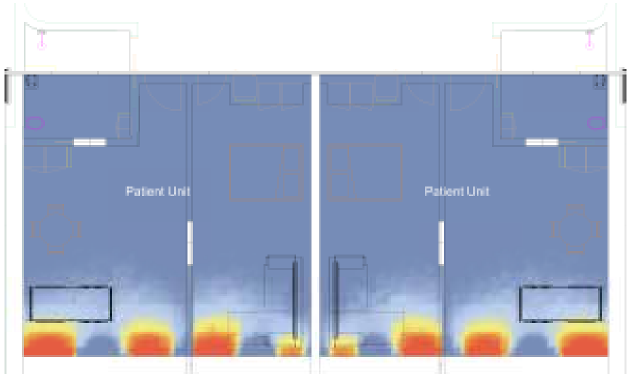
Testing facade iteration 10 shows that less daylight enters in the unit compared to iteration 1 but the amount of radiation is minimized to prevent overheating seen on illustration 132. Adding skylights adds a significant amount of daylight in the patient unit without excessive amounts of solar radiation. This helps preventing overheating issues inside the patient units while securing daylight enters and illuminates the unit.



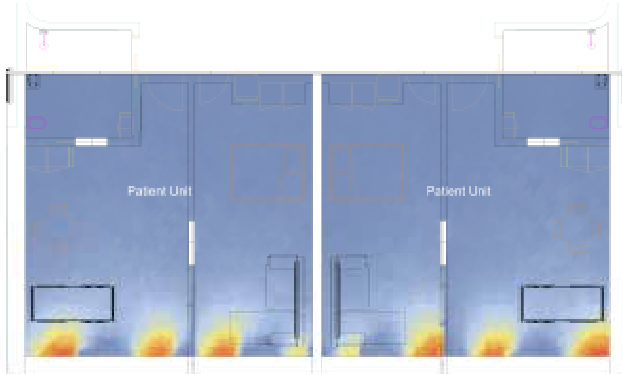
Ill. 129: daylight test of Iteration 1



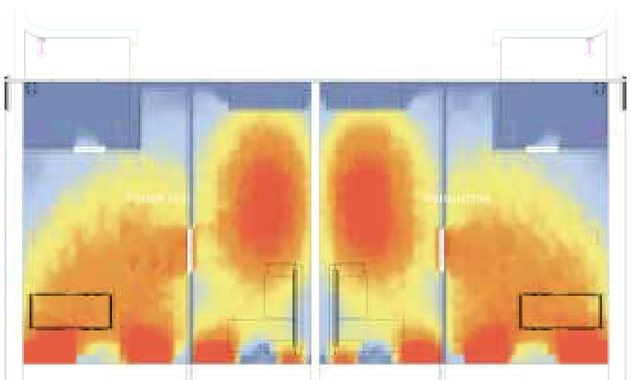
Ill. 130: Radiation test of Iteration 1



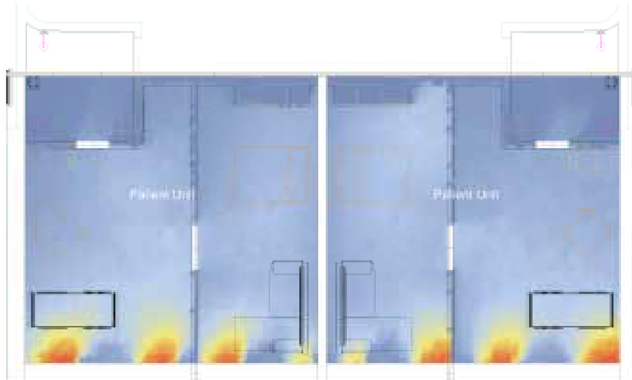
Ill. 131: daylight test of Iteration 10



Ill. 132: Radiation test of Iteration 10



Ill. 133: daylight test of Iteration 10 with skylight



Ill. 134: Radiation test of Iteration 10 with skylight

Ill. 135: Iteration 1

Ill. 136: Iteration 2

Ill. 137: Iteration 3

Ill. 138: Iteration 4

Ill. 139: Iteration 5

Ill. 140: Iteration 6

Ill. 141: Iteration 7

Ill. 142: Iteration 8

With a system chosen for the facade it became a matter of choosing how to compose it. The glass door and the larger windows were set, so importance were placed on the number and placement of smaller windows.

The function of the smaller windows is to create glimpses into the surrounding landscape. By creating these glimpses the children's playfulness should be engaged and stimulated. The windows will also provide a degree of light, although it will be diffused mostly.

The windowsills can also be used to decorate the rooms and help achieve a homely atmosphere.

Iteration 1:

No smaller windows are present in the façade. The space is monotone and playfulness is lacking from the façade. Something is obviously missing.

Iteration 2:

The small window makes the composition feel more complete. It is still very stringent and a certain institutional dullness hangs over it.

Iteration 3:

The second small window seems somewhat misplaced in the compositions. There are still a lack of playfulness.

Iteration 4:

Adding an extra window starts to stir the composition pleasantly, the view consider all elevations.

Iteration 5:

With four windows a new flowing composition becomes apparent. There are plenty of different views but still with a feeling of blocking view from the exterior.

Iteration 6:

Expanding the system the façade takes on an expressive composition. This may not be fit for the patient unit.

Iteration 7:

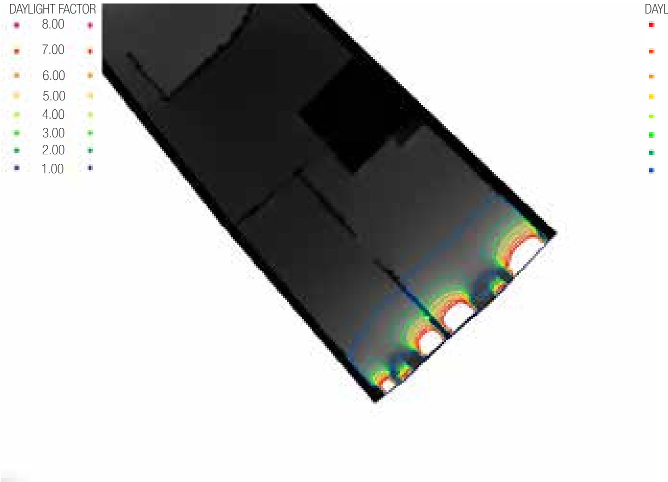
Somewhat more controlled with smaller windows, though most of them are placed too high for utilization.

Iteration 8:

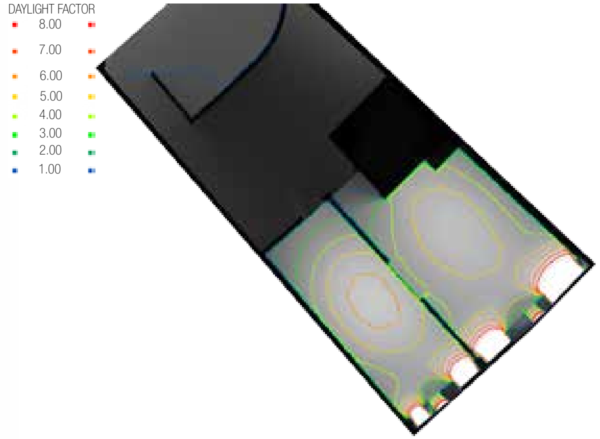
The smaller windows become too dominating and starts to act like one large partitioned glass surface. Allowing too much view from exterior and becomes overwhelmingly chaotic.

Conclusion:

Iteration 5 was chosen for its ability to create a playful composition in the façade without overwhelming the interior space. It allows for different views as one moves around in the room and still blocks view from the exterior. There are enough spaces to allow for personalization in the room.



Ill. 143: Daylight of the unit without skylights



Ill. 144: Daylight of the unit with skylights

DAYLIGHT

Daylight have been handled differently throughout the building. The different functions have very different daylight requirements. While the required lux and daylight factors need to be reached on account of law, the atmospheres created by the light play an equally important role in the palliative treatment. (Frandsen, 2011)

Early in the process the different functions were aligned regarding towards the sun.

In Nordic architecture light is central, the light in the north changes greatly throughout the day and the year. Often the light is diffused and filtered through cloud cover.

Staff:

Most of the staff functions were placed in the northern part of the building. The staff functions needs a minimum daylight factor of 3 and lux level of 200. Offices, like what most of the staff functions are, generally benefit more from a stable diffuse light. The northern light prevents overheating or intrusive glare.

Patient units:

The patient units required a more refined approach since parameters that are more delicate were in consideration. It was important to not only consider the measurable aspects, but take into consideration what atmosphere the light creates and which functions the window placement serve within the space.

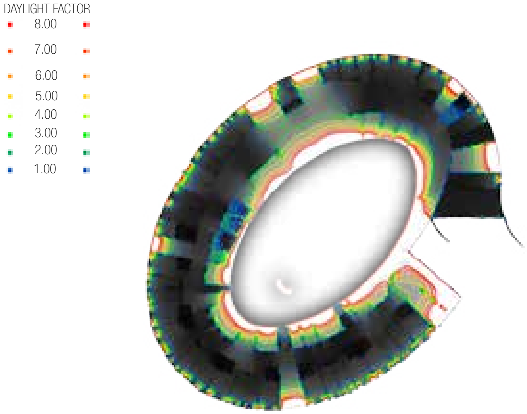
Creating the openings to facilitate daylight have been an extensive process. The façade were determined to be facing the lake as much as possible. Since the lake is south southeastern to the site there would be a very real risk of overheating, and a risk of the inhabitants feeling exposed if large glass facades were utilized. (Hørlück, S. 2016)

Further test in light simulations proved that the patient units would be too deep for a full glass façade to provide necessary light. Therefore, the openings in that façade should provide views to the outside, one large window per room and several smaller. The small windows gives the inhabitants shifting view of the surrounding landscape, and provides space for personal trinkets helping the patient to feel at home in the unit. In neuro aesthetics it has been proven that the stressful conditions can be alleviated greatly when the subject had a window within his/her view, if the window opened into a landscape the stress reactions were further alleviated. Hence, the patient unit needs to feel open from the inside while still blocking views from the outside. (Vartanian et al., 2015)

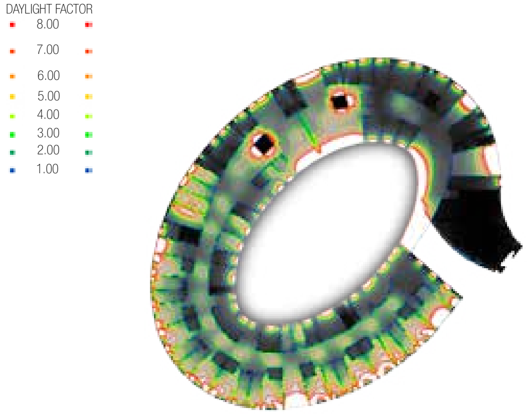
Daylight controls a great deal of human biological and psychological wellbeing. Light controls sleep patterns and moods. It is important that the intensity of light can be controlled. A person in pain will at times feel bright lights as catalyst increasing the experienced pain. Shading sunlight is also necessary to control the indoor climate, which as mentioned in the program is paramount in palliative treatment. (PAVI, 2016)

Skylights were per testing necessary to provide the needed daylight. These would be able to open slightly to facilitate further natural ventilation, and use a shading system with a shading value of 0,3. One skylight of 1x1.5 meters would be placed in both rooms in the patient unit, skylights would be placed between the rafters. A skylight in the patients room are placed above the bed to give the patient a view to the sky, simmelar skylights in places in the leatives room. This windows raises the light levels in both rooms significantly but in the patient room the entrance hallway and ceiling ridge remain dark.

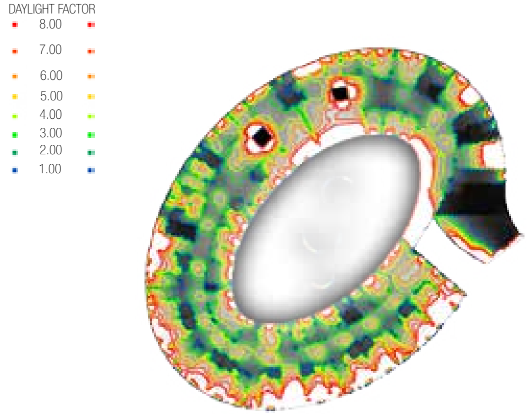
Instead of just placing another skylight a series of smaller skylights are placed along the ridge of the roof. This creates a lively play of light on the ceiling and walls. The angle toward the skylight along the ridge of the



Ill. 145: Daylight of the building without skylights



Ill. 146: Daylight of the building some skylights



Ill. 147: Daylight of the building optimized skylights

ceiling is such that the child in sitting position can look out at the sky.

The patient units are covered in wooden cladding of light coloration, that reflects the light softly and with slight colour tinge. The light in patient units is soft but plentiful, propagating throughout the space leaving no dark nooks and crannies. It is welcoming and calming, and when the daylight fades or becomes too much fro the ill patients the highly customizable artificial lighting takes over.

Hallways:

Throughout the process, the hallways have been developed as an interior space encapsulated by outer and inner facing functions. It has been the goal to separate this space from the remaining, drawing daylight trough skylights and interior gardens, avoiding dark spaces that would be detrimental to the palliative care. By creating small interior gardens both light and nature is drawn into the building. The gardens divide space and blends the hallway with the exterior. While the smaller interior gardens were made exclusive to the entrance, one larger encompassed by the building volume marks the center of the complex. Some functions like playrooms flow into the hallway, and the garden. This draws in large amounts of mostly diffuse light. It also opens the otherwise closed hallway up, creating a feeling of kinetical openness as described by experiments in "The Trier Social Stress Test "(Brorson Fich, 2015) which together with the curved hallway and tall rooms should create a more pleasant baseline for the spatial experience on a neurological stage. (Vartanian et al., 2015) (Vartanian et al., 2013)

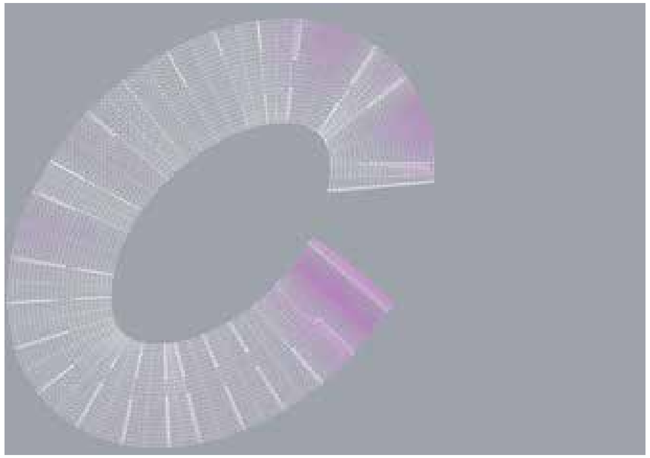
Skylights are placed in the ceiling in pairs on each gable roof, a large skylight and a smaller. At first, only the large skylight was placed to meet daylighting requirements. Creating smaller skylights allowed for a differentiated light that also served as way to differentiate the directional movement in the building. The skylight allow direct light to enter the hallway and in the true fashion of Nordic architecture makes the arrow of time palpable in the space. Giving the facing windows different dimensions and placements, but keeping these consistent throughout the building underlines the flow and sense of direction in the complex an important feature for palliative patients. (PAVI, 2016)

The hallway are bright, but by using skylights and punctuated openings, the hallways are not flooded in direct light. The brightness comes from the bright materials diffusing the light entering from the skylights. The openings into niches creates a changing intensity differentiating areas of the building. The light is calm and diffused but not dim.

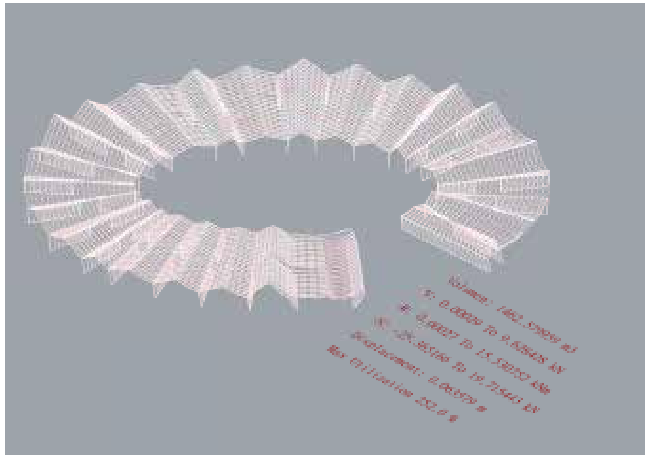
Daycenter:

The arrival and daycenter should be bright and welcoming (Nissen et al., 2008); curtain walls opening to the interior gardens flood the space in daylight, and provides vistas throughout the building. To counteract overheating trees are placed in front of the curtain wall. Skylights are placed as in the hallways.

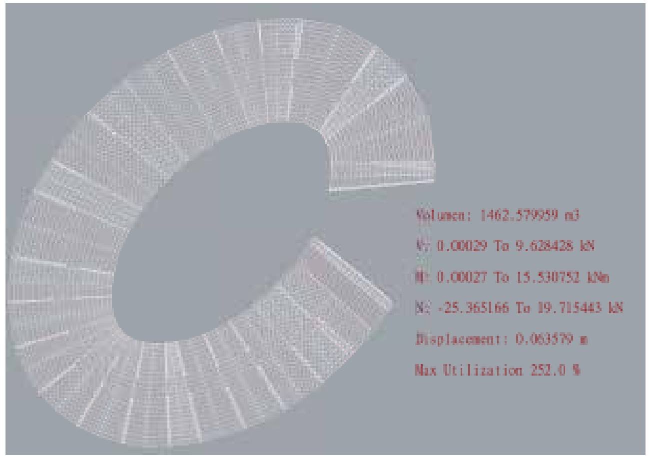
At each end of the daycenter, the interior gardens differentiate the hallway from the remaining flow, and flank the arrivals in natural beauty.



Ill. 148: Iteration 1 displacement



Ill. 149: Iteration 1 utilization



Ill. 150: Iteration 1 utilization

CONSTRUCTION

The structure is a single story building with a series of interconnected gable roofs. The structure is entirely timber and consists of beams placed along the ridge and foot of the roof, connected by rafters. The beams at the foot of the roofs rests on either load bearing walls or pillars. Columns are placed at either end of the lower beam. Wood panels connect the individual rafters, which stabilizes the structure. 5x5 crossbeams in the structural model simulate the panels.
The structure is fairly simply. Two complications arise from the chosen structure.
Stabilizing collar beams are not chosen. Since the interior ceiling follows the roof for allowing daylight to enter the building unhindered. This means that the collar beams are exposed; while this could be, an aesthetic choice dust would gather on the top of the beams complicating the regular cleaning routines in the hospice. Therefore the structure will depend on the ridge beam to take the brunt force from the rafters' moment. The rafters will likewise lack the stabilizing effect and would be dimensioned to counteract the potential deformation.
As mentioned the roof structure lead will be more vulnerable to accumulating snow in the valley gutters. Combined with the location of the building in a forest, where there are next to no wind, the snow will not be drifting but fall firmly on the roof. Since the snow will slide down surfaces with large pitches, the load will be heaviest along the valley gutters. The load will linearly decrease along the rafter towards the ridge.
Wind load have not been considered, because of the building site the snowload will the dimensioning load. The lack of wind is taken into account by increasing snowload appropriately. The wind rose in the site analysis shows the direction of the hardest wind gusts corresponds with the heaviest forestation on the site.
Through several iterations, different dimensions have been tested in the structure. The aim was to reach around 85-90% utilization, to take into account unforeseen factors that these more superficial calculations does not take into account.
The calculation were made by following the formulas provided in Eurocode 1. Since snow load were determined to be the main load, the calculations primarily focuses on that.
The included load are the gravitational load of the structure, the load of the roof construction and the snow load. All structural elements and loads assembles and calculates via FEM using the Karamba plugin for Grasshopper.
Test materials were Glulam 32H and Glulam 28C, using characteristic material value found in Teknisk Ståbi page 304

Strength Class	GL 32h	GL 28c
$f_{m,k}$	32 MPa	28 MPA
$f_{c,0,k}$	29 MPa	24 MPa
$E_{0,k}$	11100 MPa	10200 MPa
G	850 MPa	720 MPa
$\rho_{12,k}$	430 kg/m³	380 kg/m³

(Jensen, 2013)

Calculating snow load:
$s=\mu_i C_e C_t s_k$
(Dansk standard, 2010)

Where:

μ_i : Is the form factor

C_e*: is the topographical factor, in this case 1,2 because of the forested site (Eurocode 1 p.53)*

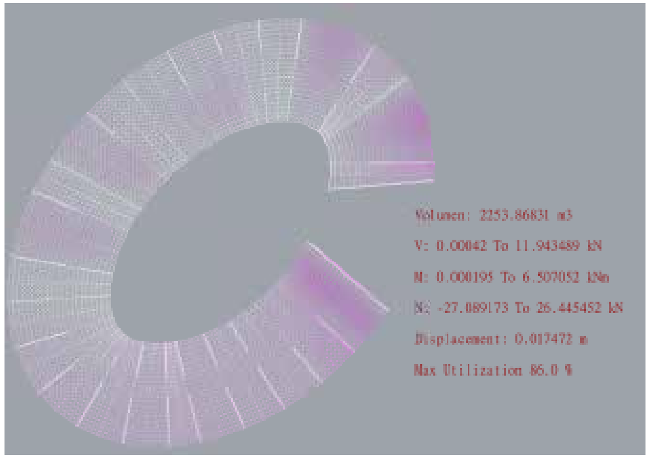
C_t*: is the thermal factor, in this case 1 since the thermal transmission is ordinary Eurocodes 1 p. 53*

s_k*: is the characteristic terrain value, 0,9 kN/m2 is the standard value in Denmark. Eurocodes 1 p. 50*

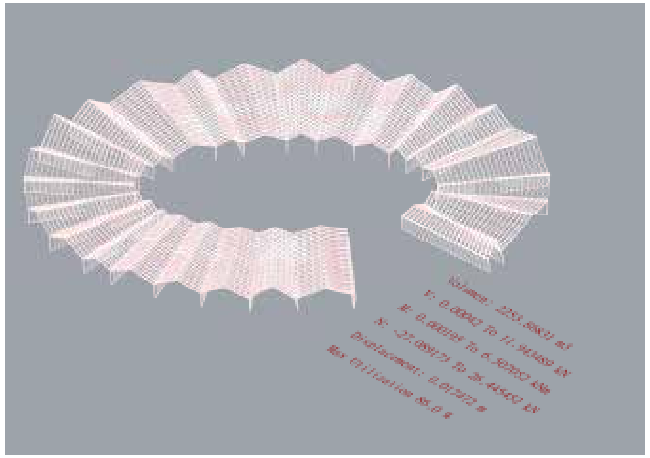
Calculating μ_i*:*

a: is the roof angle.

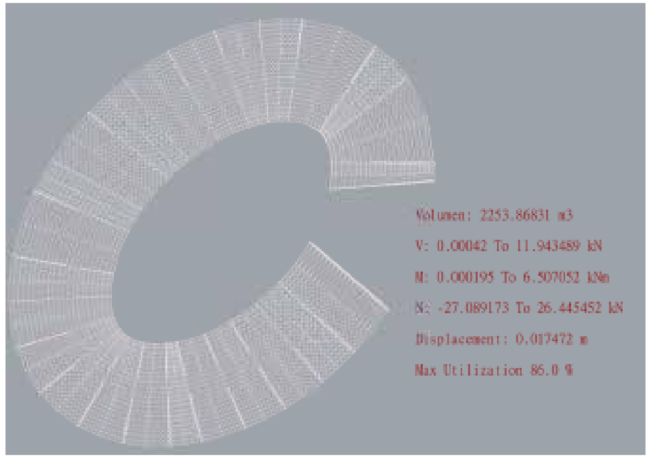
Starting out the two "end" roof surfaces are calculated pitched roofs, while



Ill. 151: Iteration 4 displacement



Ill. 152: Iteration 4 utilization



Ill. 153: Iteration 4 utilization

the remainder is calculated as through roofs.
All calculations refer to pages 53-55 in Eurocode 1 *(Dansk Standard, 2010)*

Roof slope α	$0° \leq \alpha \leq 30°$	$30° < \alpha < 60°$	$\alpha \geq 60°$
μ_1	0,8	$0,8(60-\alpha)/30$	0,0
μ_2	$0,8 + 0,8\alpha/30$	1,6	-

(Dansk Standard, 2010)

Where μ_1 is the form factor for the end surfaces, and μ_2 is the form factor for the through roofs. μ_2 follows the linear function μ_2 (*a*) where *a*=$(a_1+a_2)/2$. a_1 and a_2 is the angle of the opposing roof slopes. The load will be 0 by the ridge and μ_2 (*a*) at the valley.

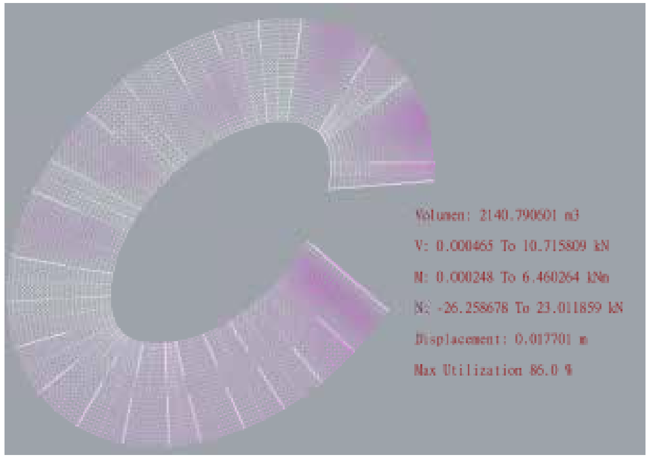
In grasshopper the roof surfaces is distributed accordingly to the carrying rafters, the rafter themselves are split into smaller segments, with a rising form factor from ridge to valley. Therefor the form factor is different for every single beam in the model. Since the pitches are very narrow in the build μ_2 is 1,6 regularly.

Load of the roof construction is calculated by finding the average density of the construction, then multiplying this with the construction thickness and the area associated with the load bearing rafter.
The loads are applied to the relevant rafters together with the total construction load.
Iterations:
In following experiments the different materials and dimensions on the structural elements are given in text. The results are displayed on the illustration.
(Dansk Standard, 2010)

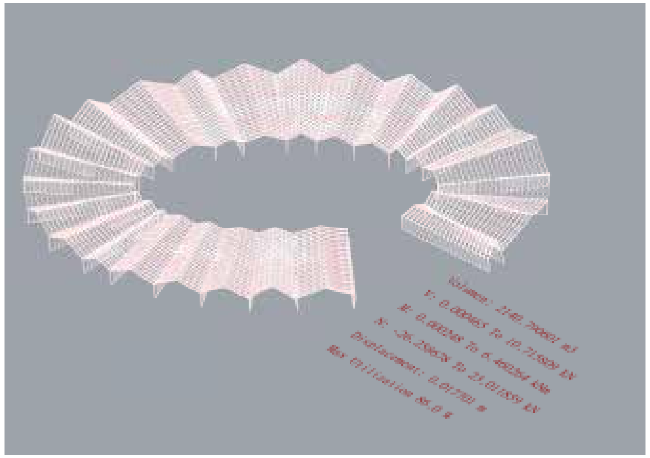
Iteration 1:
The first iteration is under-dimensioned greatly. In further tests, dimensions will be increased equally on all beams and rafters until a satisfactory utilization and displacement are reached.

Parameters:
Material: Gl32h
Rafters Dist: 0,95 m
Rafters: H: 20 cm W: 5 cm
Pitch Beam: H: 20 cm W: 5 cm
Foot Beam: H: 20 cm W: 5 cm
End Columns: D: 18 cm T: 5 cm

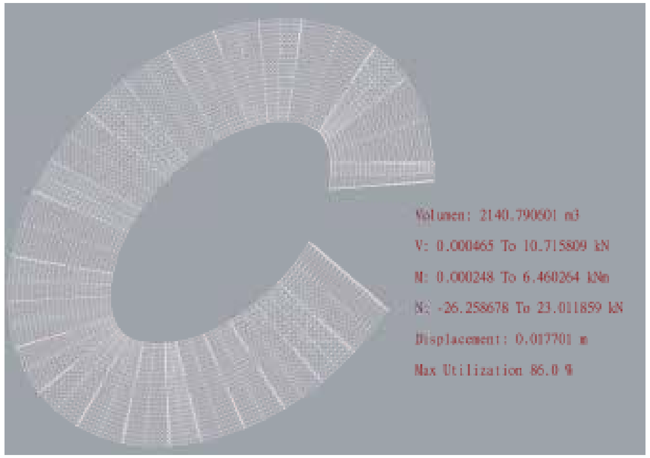
Results :
Volume: 1462,58 m3
V: 0,00029 to 9,628428 kN
M: 0,00027 to 15,530752 kNm
N: -25,365166 to 19,715443 kN
Displacement: 0,053579 m
Max Utilization: 252,0 %



Ill. 154: Iteration 7 displacement



Ill. 155: Iteration 7 utilization



Ill. 156: Iteration 7 utilization

Iteration 4:
The structure is dimensioned appropriately to withstand the forces with the current material strength. Further tests will reveal which parts of the structure are important by decreasing the elements dimensions until breakage. This is done to optimize material usage.

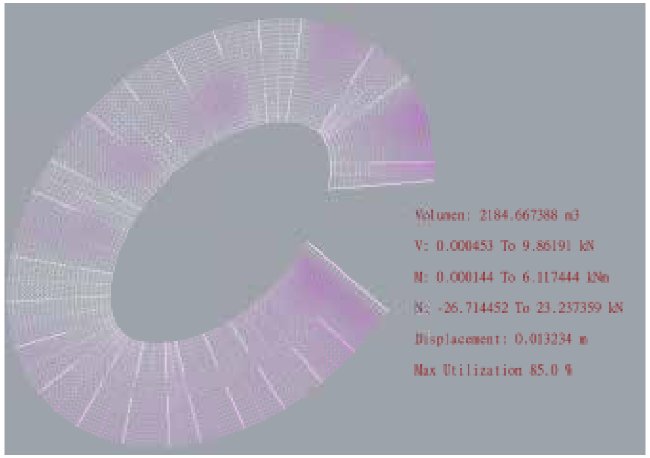
Parameters:	
Material	Gl23h
Rafters Dist:	0,95 m
Rafters:	H: 40 cm W: 5 cm
Pitch Beam:	H: 40 cm W: 5 cm
Foot Beam:	H: 40 cm W: 5 cm
End Columns:	D: 20 cm T: 10 cm

Results :	
Volume:	2253,86831 m3
V:	0,00042 to 11,943489 kN
M:	0,000195 to 6,507053 kNm
N:	-27,089173 to 26,445452 kN
Displacement:	0,01472 m
Max Utilization:	85,0%

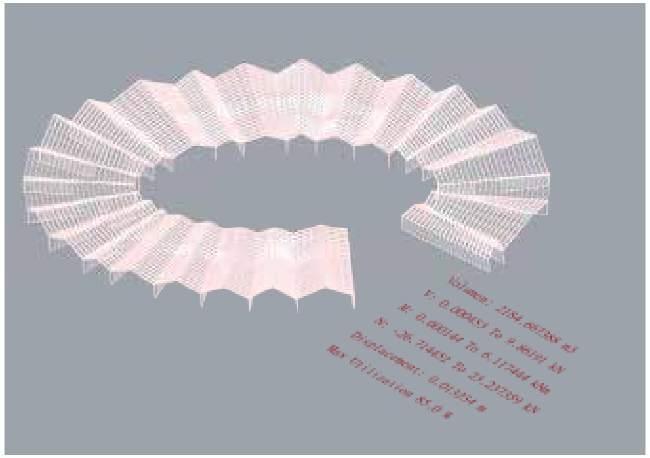
Iteration 7:
The rafters are the structural element most exposed the forces, it is impossible to lower their dimensions without weakening the structure. The beams can easily be decreased in size without any greater effect on the structure.

Parameters:	
Material	Gl32h
Rafters Dist:	0,95 m
Rafters:	H: 40 cm W: 5 cm
Pitch Beam:	H: 30 cm W: 5 cm
Foot Beam:	H: 20 cm W: 5 cm
End Columns:	D: 20 cm T: 7 cm

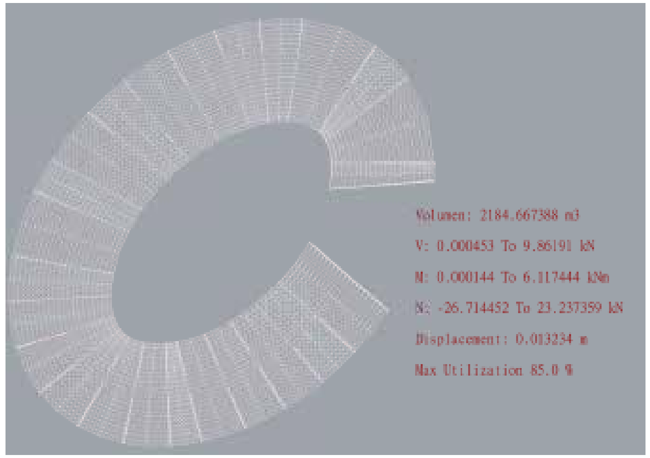
Results :	
Volume:	2140,790501 m3
V:	0,000465 to 10,715809 kN
M:	0,000248 to 6,460264 kNm
N:	-26,258678 to 23,011859 kN
Displacement:	0,017701 m
Max Utilization:	85,0%



Ill. 157: Iteration 9 displacement



Ill. 158: Iteration 9 utilization



Ill. 159: Iteration 9 utilization

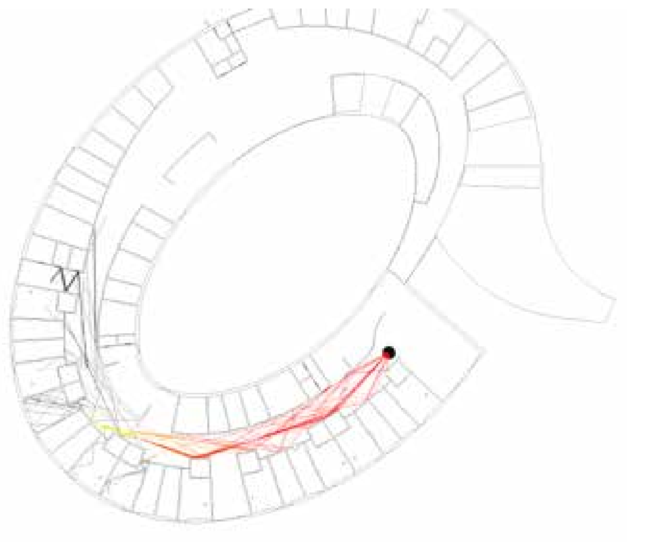
Iteration 9:
Testing is done using a cheaper glulam material, the rafters need to be increased by 10 cm in height to maintain a stable structure, and remaining dimensions are identical.

Parameters:

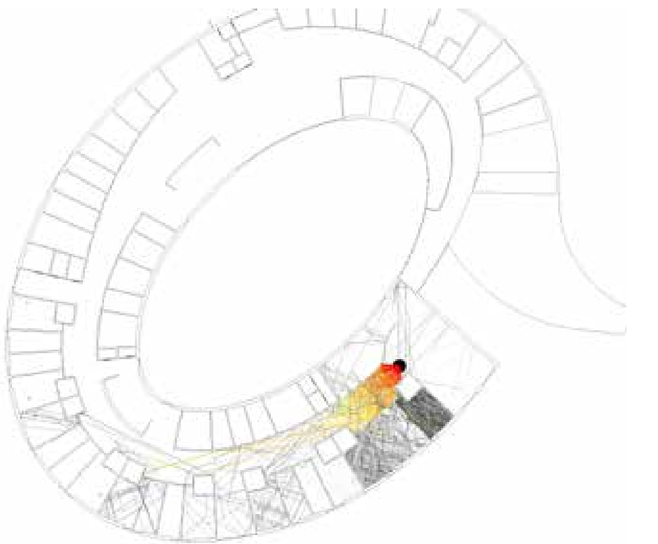
Material	Gl28c
Rafters Dist:	0,95 m
Rafters:	H: 50 cm W: 5 cm
Pitch Beam:	H: 30 cm W: 5 cm
Foot Beam:	H: 20 cm W: 5 cm
End Columns:	D: 20 cm T: 7 cm

Results :

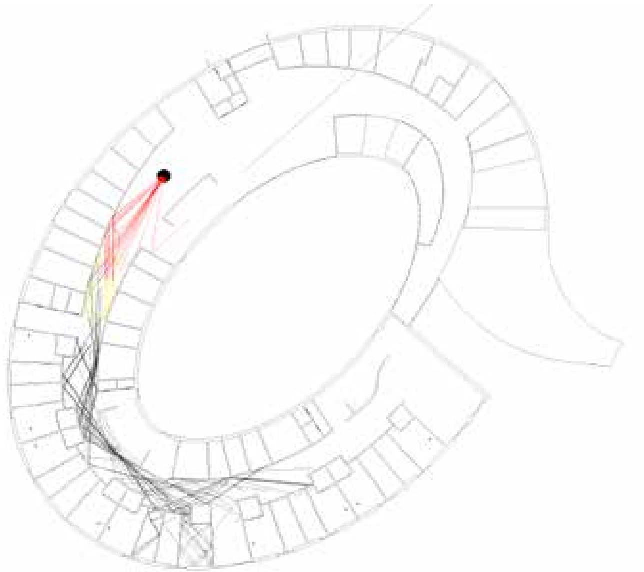
Volume:	2184,667388 m3
V:	0,000453 to 9,86191 kN
M:	0,000144 to 6,117444 kNm
N:	-26,714452 to 23,237359 kN
Displacement:	0,013234 m
Max Utilization:	85,0%



Ill. 160: 30 longest bounces from the common room



Ill. 161: Sound propagating into the patient unit from the common room



Ill. 162: 30 Longest bounces from the daycenter

ACOUSTICS

Materials and geometry primarily influence acoustics. Convex shapes will diffuse sound while concave focuses. Center to the plan are the ellipsoid hallway, containing a diffusing inner wall and a outer focusing wall. The problems encountered in such a geometry, will be long sound reflections propagating along the focusing wall. These reflections will only encounter few surfaces, therefore it is important to counter them with absorbing materials.

Acoustics play a major role in both healing architecture and palliative treatments. Auditory disturbances are hard to control for the individual and can be a major stress factor for medical patients. Since the calm and quiet is a major point for choosing the site, it is important that these qualities are upheld within the building.

In the case of this building, there is a danger of sound propagating from the hallways and common functions into the patient units. While the entrance doors will block sound when closed, there are either many situations where the door will need to be open or where the patient might find it desirable.

By raytracing reflective patterns, problems stemming from the building's geometry is mapped. The niches in front of the patient units mostly stops the long reflections. But the extruded bathroom cores provides plenty of surfaces area to propagate sound through the hallway. It is important to clad the extruded walls, facing the hallway, in absorbing and/or diffusing materials.

The bathroom cores are also problematic in regards to sound propagating into the patient units. The sound will reflect off the door and into the hallway. The solution is to place absorbing materials in the entrance hallway, since the sound will need at least one reflection to reach inhabited space within the patients' rooms. The family room are somewhat more exposed to direct reflections from the core. However, these are fewer because of the angel between the room opening and the core surface, for this reason the reflections will often have propagated for longer before encountering the bathroom core.

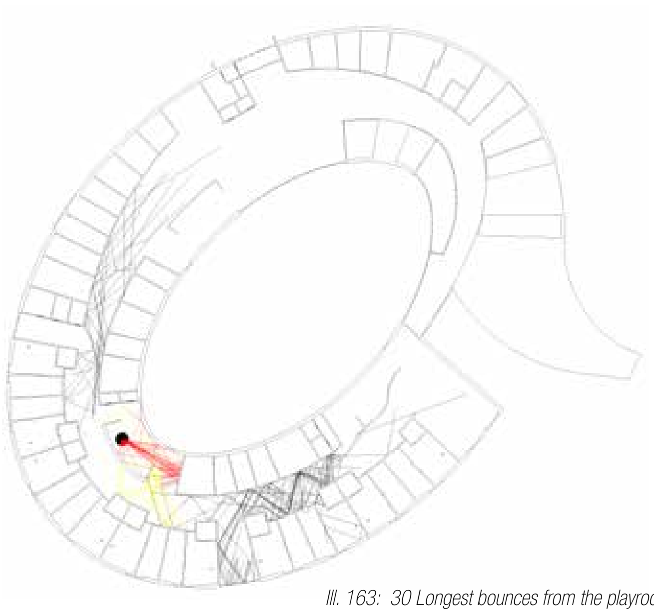
Noise is often associated with children, and since this is a building dedicated to children, it is important to take into account the disturbances the play area or common room can have on the remaining rooms. The room is cladded to fit child's play, meaning soft surfaces and plenty of objects to interact with. The surfaces and objects will go a long way in absorbing and diffusing sound propagation from the area. Cladding or absorbing furniture may be required in the spaces leading into the play area.

Raytracing the noise patterns is important in mapping potential problems.

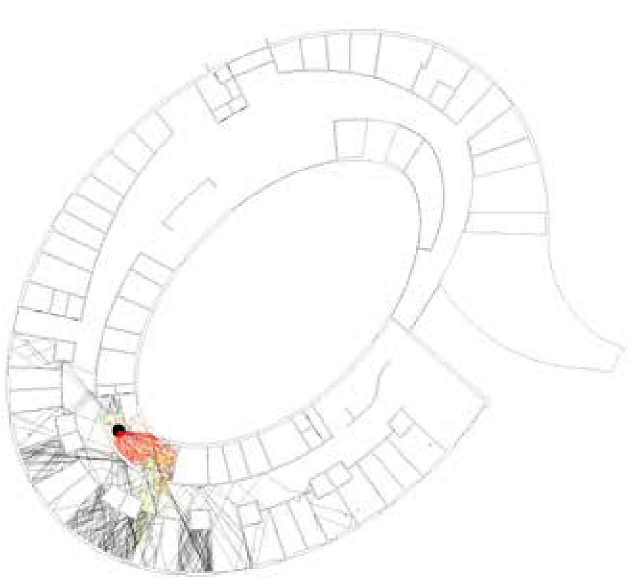
Concrete calculations are needed in certain areas to test whether the reverberation time. For this building test are performed in the daycenter/arrival and patient units. The maximum reverberation times in both areas are found in "Tekniske standarder, Vejledende luftskifter og lydtryksniveauer". (Odense Universitetshospital, 2012).

The calculations show that the day center reaches 0,8 s reverb at 500 Hz. This is likely a result of the room geometry with several ridges in the ceiling, combined with plenty nooks and crannies that traps the sound. The entire ceiling is covered in acoustic paneling, since the ceiling encompasses a huge surface area, the sound is efficiently absorbed and diffused.

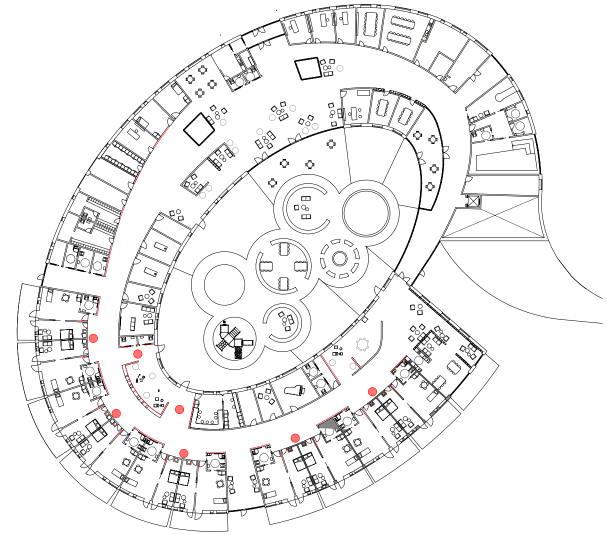
In the patient unit the reverberation is 0,4 s at 500 Hz. This is likely the result of a room that is largely cladded in wooden panels, and has a large surface compared to volume.



Ill. 163: 30 Longest bounces from the playroom



Ill. 164: Sound propagating into the patient unit from playarea



Ill. 165: Placement of acoustic materials


PRESENTATION

Ill. 166: 1:1500 Site plan

Site plan in the scale 1:500 can be found in the attached drawing folder

Accessibility in a hospice is vital. The existing access roads are converted into 6 m wide permeable concrete roads that allow rainwater to penetrate leaving dry access road. It is important that the inhabitants, who are often very weak, can gain access to most of the building even in a bedridden condition. Arrival on the north side of the building is designed so that patient arrives directly by car into a drop-off zone with a sheltering overhang. This area is mostly planar with only a slight incline of max 1% that leads surface water away from the entrance. A nearby parking lot northwest of the main entrance fits 35 cars, incl. four spots reserved for disabled, and allows for long term parking for relatives and staff, with connecting path to staff entry and the main entrance.

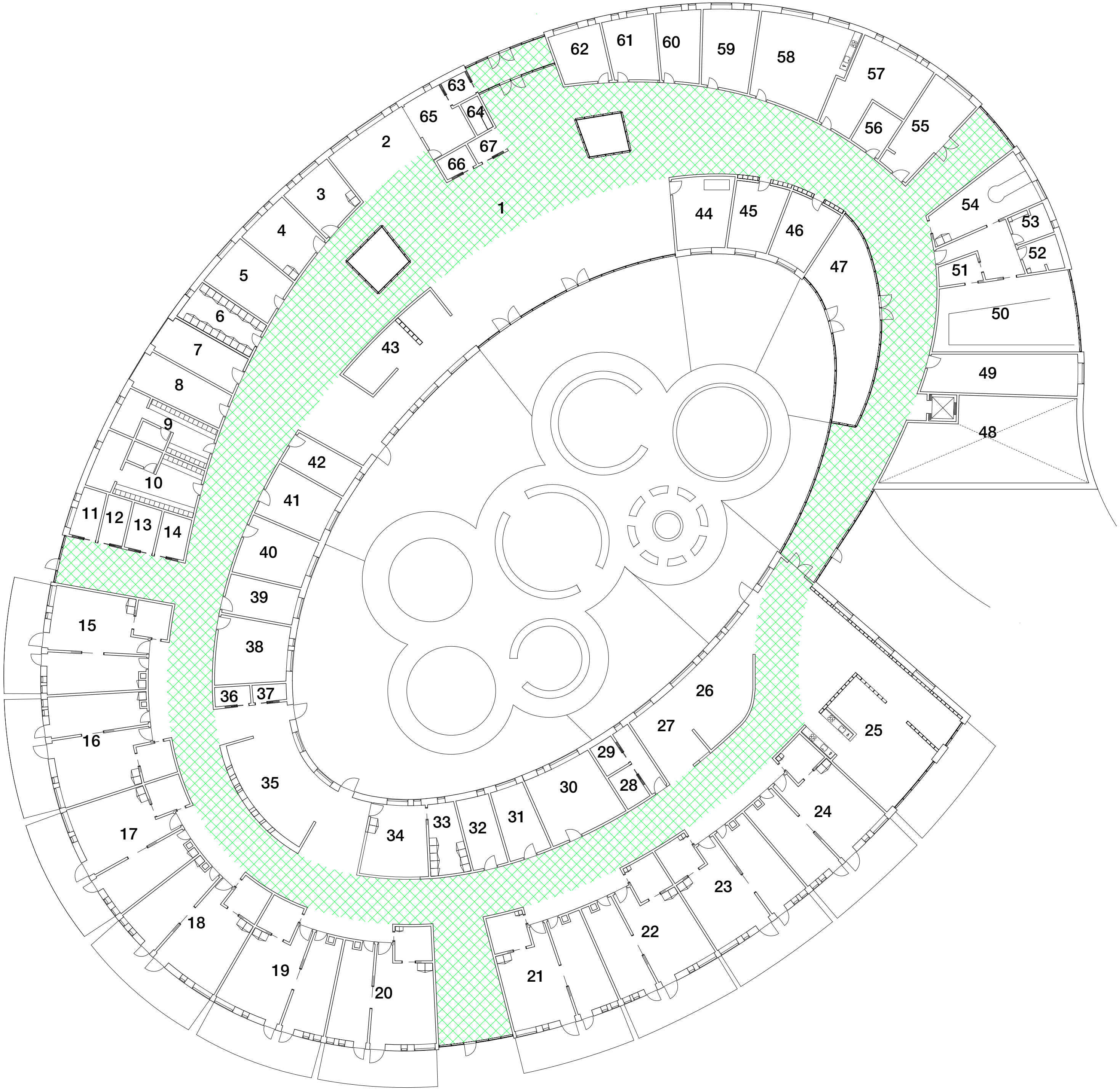
Departure from the hospice has been placed on the northeast side of the complex, and while allowing for a beautiful view toward the lake, it shelters towards the main road by using small trees to create picturesque scenes for the last farewell.
Nature is an important aspect in palliative architecture, and is the main reason for the choosing the site. Fitting the building onto the site, some of the existing paths will be slightly altered. In doing this wood paving will be laid down on the paths. The altered paths will be sloped along natural elevations to minimize steep paths. With these parameters in mind the patients will be able to traverse the paths around the building, and gain access to the lakeside in bed or wheelchair. The altered pathways that connects existing routes has also been established in order for hikers, mountain bikers, and runners etc. to still be able to use the area surrounding the building. Signs will be put up informing about the possible encounter with disabled pedestrians.


Ill. 167: Visualization of the project from the lake

The final design fits with the contours of the landscape, and grabs on to the terrain by extending a tail from the building that becomes a walk way continuing into the lake. The vertical wood cladding plays on the verticality of the surrounding forest, while the large windows facilitates a stress releasing view of nature. The cabin expression offers a familiar style while creating a roof design divided by function, making the complex easy to comprehend.

The circular shape of the design creates a closed and safe inner courtyard that offers a sensory outdoor experience, where patients are in control contrasting the natural rawness of the context.

The design also fulfills the critiria of the danish buildings regulations 2020 Energy frame and indoor environment, while also reaching status of a net zero energy building.

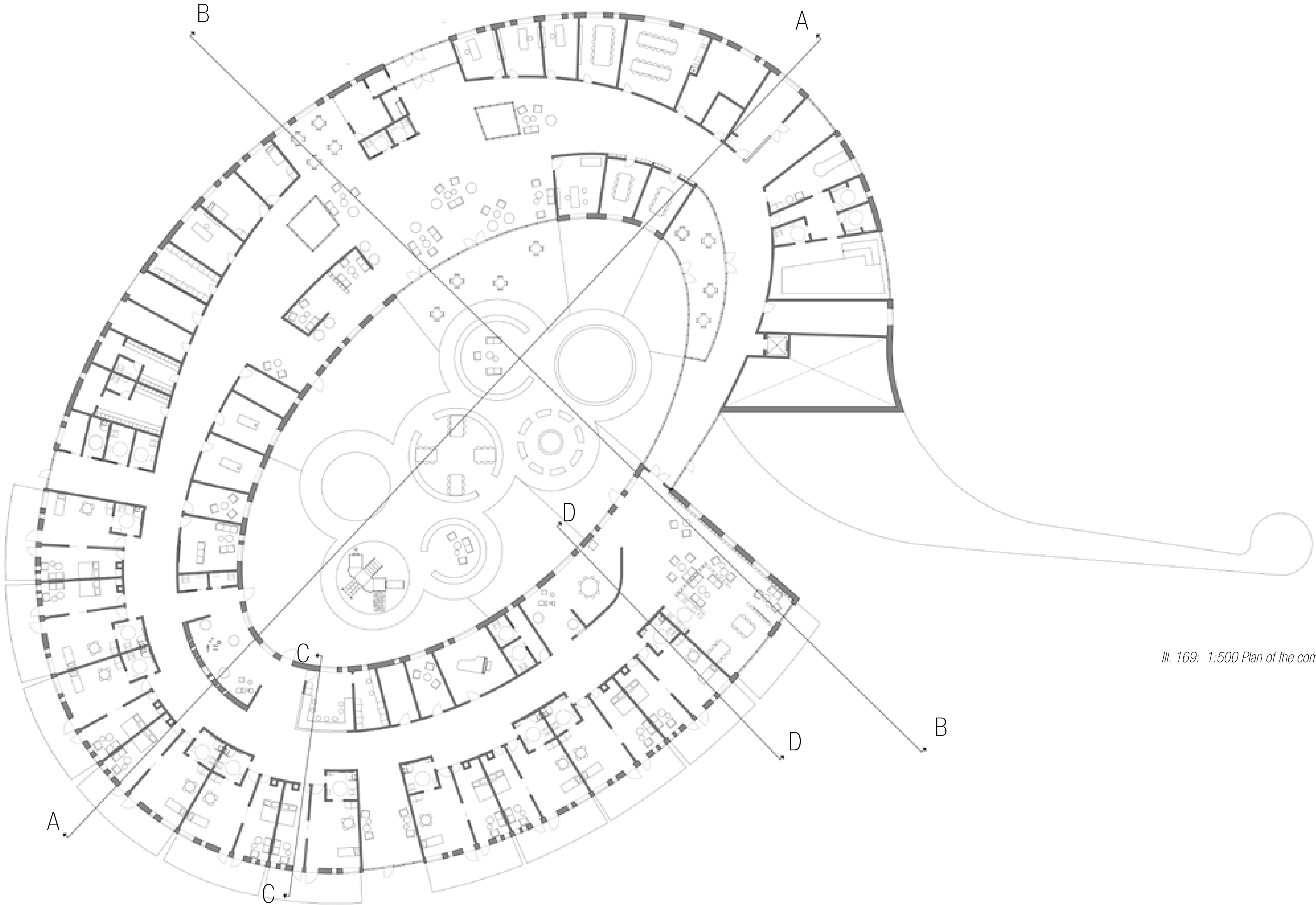


Ill. 168: Plan with escape routes

1	DAYCENTER - 303 m^2
2	CANTINA
3	GUEST UNIT - 19 m^2
4	GUEST UNIT - 22 m^2
5	JANITOR OFFICE - 23 m^2
6	TECHNICAL ROOM - 20 m^2
7	LINED ROOM - 22 m^2
8	WASTE ROOM - 22 m^2
9	MALE CHANGING ROOM - 26 m^2
10	FEMALE CHANGING ROOM - 36 m^2
11	LAUNDRY ROOM - 8 m^2
12	SHOWER - 7 m^2
13	H-TOILET - 8 m^2
14	H-TOILET - 8 m^2
15	PATIENT UNIT - 64 m^2
16	PATIENT UNIT - 64 m^2
17	PATIENT UNIT - 64 m^2
18	PATIENT UNIT - 64 m^2
19	PATIENT UNIT - 64 m^2
20	PATIENT UNIT - 64 m^2
21	PATIENT UNIT - 64 m^2
22	PATIENT UNIT - 64 m^2
23	PATIENt UNIT - 64 m^2
24	PATIENT UNIT - 64 m^2
25	COMMON ROOM - 101 m^2
26	CREATIVE AREA - 32 m^2
27	PLAY AREA - 22 m^2
28	H-TOILET - 6 m^2
29	H-TOILET - 6 m^2
30	MUSIC ROOM - 34 m^2
31	CONVERSATION ROOM -17 m^2
32	WASHING ROOM - 15 m^2
33	MEDICIN ROOM - 15 m^2
34	STAFF WATCH - 27 m^2
35	PLAY AREA - 44 m^2
36	TOILET - 5 m^2
37	TOILET - 5 m^2
38	TEEN ROOM - 28 m^2
39	CONVERSATION ROOM - 17 m^2
40	THERAPY ROOM - 24 m^2
41	THERAPY ROOM - 23 m^2
42	CLEANING UTILITIES - 15 m^2
43	LIBRARY - 49 m^2
44	CONSULTATION - 25 m^2
45	MEETING ROOM - 20 m^2
46	MEETING ROOM - 20 m^2
47	ORANGERIE - 58 m^2
48	BASEMENT REMOTE DEPOT - 89 m^2
49	TECHNICAL ROOM - 38 m^2
50	BASIN - 63 m^2
51	H-TOILET - 6 m^2
52	CHANGING ROOM - 7 m^2
53	CHANGING ROOM - 7 m^2
54	TUB ROOM - 30 m^2
55	REFLECTION ROOM - 28 m^2
56	COPY ROOM - 9 m^2
57	ARCHIVE - 36 m^2
58	STAFF GROUP ROOM - 50 m^2
59	DOCUMENTATION ROOM / OFFICE - 25 m^2
60	OFFICE - 18 m^2
61	OFFICE - 19 m^2
62	OFFICE - 17 m^2
63	DEPOT - 4 m^2
64	RECEPTION - 4 m^2
65	KITCHEN - 17 m^2
66	H-TOILET - 5 m^2
67	H-TOILET - 5 m^2

FIRE STRATEGY

Fire regulations demands there's a maximum of 25m to an exit that leads outside the building. (Bygningsreglementet.dk, 2016) Given the plan of the building this is fulfiilled. Each unit is a thought as a seperate fire section with individual exits. With each room using decentralized ventilation the risk of smoke spreading reduced, together with natural ventilation through skylight that can act as natural fire ventilation. (Beredskabsstyrelsen, 2016)



Ill. 169: 1:500 Plan of the complex

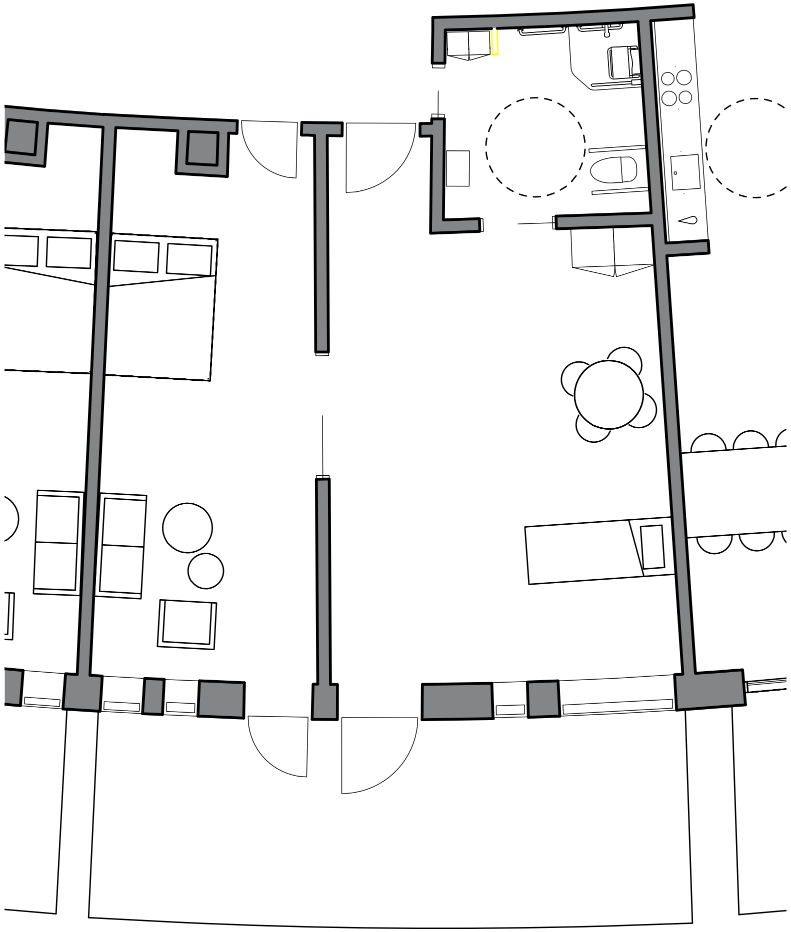
The plan in the scale 1:200 can be found in the attached drawing folder

The plan follows the concept of a circular flow that eases navigation and eliminates long and straight view through the corridor. Another defining factor is the gradient placement of functions starting from the public arrival area placed north, and slowly moving toward the private sectors including the ward and patient units placed south and southwest.

The building is completely planar, which enables the patient to move or be transported throughout the entire building without the need for elevators. Doors have a free width of 107 cm, allowing for free passage for bedridden patient and patients in wheelchair.

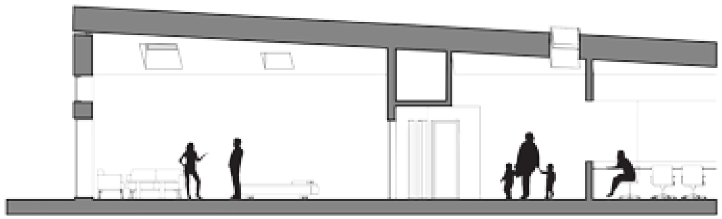
Transporting the patients through the building bedridden requires wide hallways allowing to beds to pass one another. To allow access hallways need to be 240 cm wide. In the project hallways generally flow into niches and other functions, therefor they will generally be around 350 cm wide narrowing and widening slightly. Flooring in the hallway are hydrocork, which is durable and easy to travel on by bed or wheelchair.(Aalborg Kommune: Ældre og Handicap Forvaltningen, 2013)

Turning diameters for wheelchair users are 150 cm alone and 200 cm with a helper. All units and bathrooms in the building have the necessary turning space. The terraces connected to the patient units are dimensioned for the manoeuvring of a bed. The common room is dimensioned for similar access and allows wheelchair access to the kitchen and for the dining areas and niches. (Aalborg Kommune: Ældre og Handicap Forvaltningen, 2013)



Ill. 170: Plan of patient unit

Plan and sections in the scale 1:200 can be found in the attached drawing folder



Ill. 171: Section D

Ill. 172: Section C

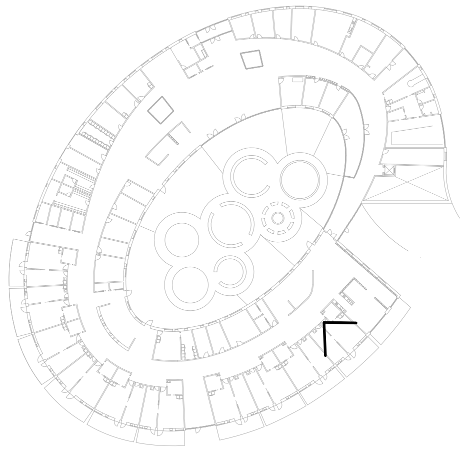
Home; this is how the inhabitants at the hospice should regard the patient units. For most of them this will be the last place they stay before passing on. They should be able to stay here with their families, while they receive palliative care from the nursing staff.
In the individual patient units everything related to temperature, indoor climate, shading and lights are controlled from a single tablet with a simple user interface. The flexible environment are important for the patient who can have wildly different requirements as part- or result of their treatment. (PAVI, 2016)

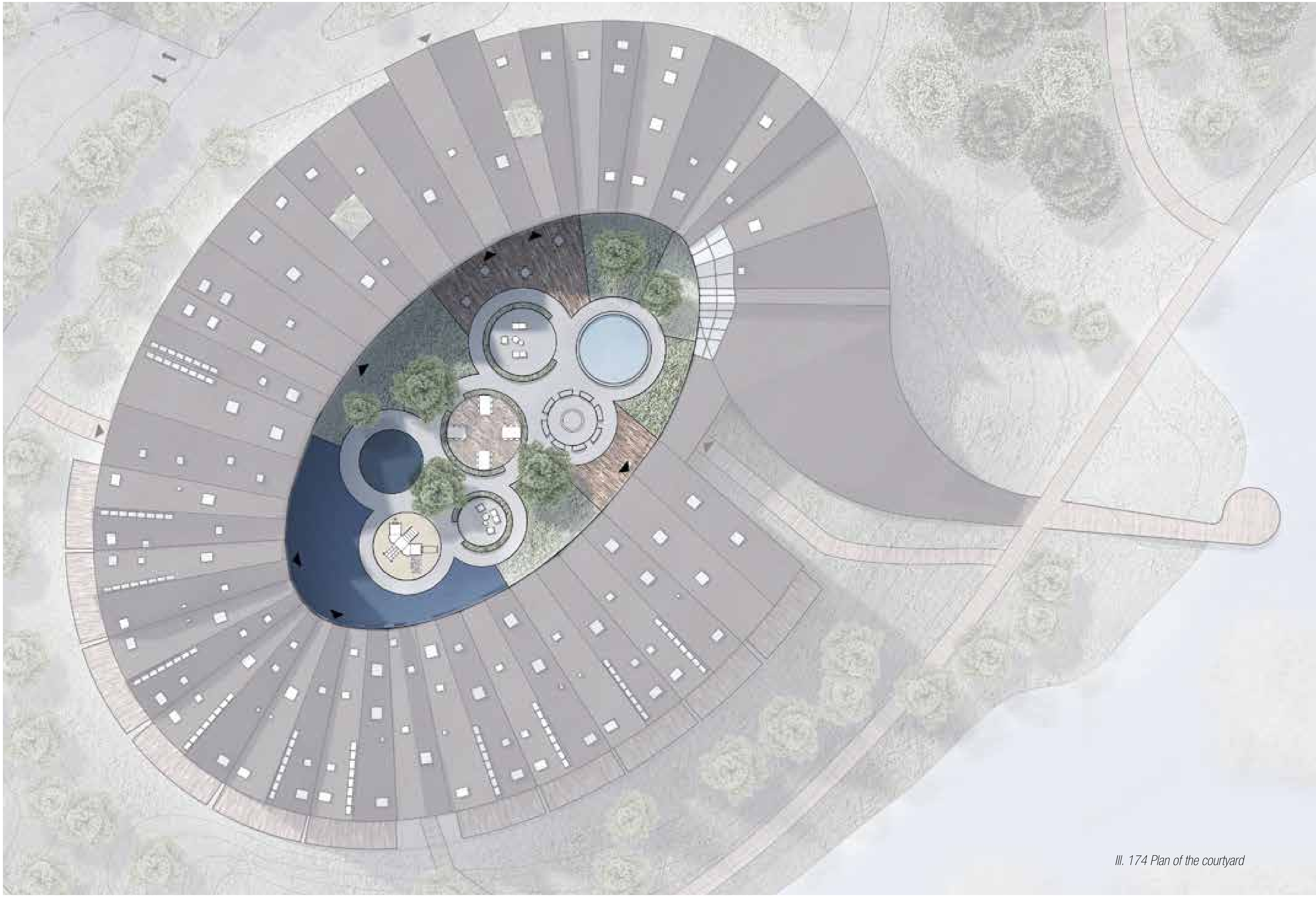
Patient units consist of three rooms, the patient room where the patient spend most time. This is the largest of the rooms allowing the family life to continue around, and involving the patient. The room will be where the patient sleeps; from the bed a lift will be able to transport the patient directly into the bathroom. A large window giving the patients an overview of the landscape also works as a sitting place for relatives or visitors. Beside the large window a glass door opens into a terrace overlooking pebermosen. The unit is cladded in bright wood, flooring is hydrocork and the walls and ceiling is cladded in white oiled oak panels. This gives the room a warm embracing atmosphere and distances it from an institutional association. The ceilings have incorporated LED lights that can be controlled by the patient from the central tablet.
The relatives room are placed next to the patient room separated by a sliding door. The door is large enough that the rooms can act as continuous space. The room is for the relatives staying with the child. While most parents chooses to sleep next to their child, many still need to go to work and sleep through the night. This could be difficult if their child needs treatment during the night, therefore the separate room. The patient may also have siblings that sleep over. The relatives room have a separate entrance, allowing relatives to come and go without disturbing the patient. (Hørlück, 2016)
The materials are the same as in the patient room.
The bathroom is connected to the patient room, but can still be accessed from the hallway. This is to counter that relatives should disturb the child when they need to use the bathroom. The bathroom is universally accessible, with a turning radius of two meters which allows access for a wheelchair user with helper. To move the expression away from the institutional, tiles are used instead of vinyl as floor cladding, the walls are tiled too. The juxtaposition of a plank floor in the room and tiled bathrooms are what one will find in most homes. The bathroom cores extrude out of the general unit volume into the hallway.
All rooms are connected with each other and the hallway without elevations or doorsteps.
Homeliness is achieved through a flexible design with recognizable forms and materials. It is important for the inhabitant that they can refit the interior to their specific needs, and are given spaces that they can personalize. The patient units are kept open with a large degree of space that facilitates plenty of furnishing options, small windows act as customizable display cases.
The units are arranged in such a way, that they create small niches on the outside, between the extruded bathroom cores. The ceiling above the niches are lowered to create a feeling of gradient privacy. Niches embody the semi private. All units are numbered and have large numbers on the doors, the numbers are plastic light diffusers lit by colored LEDs from behind, the color are changed to the child's favorite color on arrival.

Ill. 173: Visualization of the patient unit

Elevations in the scale 1:200 can be found in the attached drawing folder

As one enters the unit a clear line trough the room leads outside, into the forest green, lush, peaceful. It is framed by a room clad in white oiled wooden panels that diffuses the light in soft and welcoming colors. On the floor boards of hydrocork follows the length of the room, giving direction to it. Daylight emanates from skylights placed along the ridge of the roof. Above the patient's bed a skylight opens into the outside where birds roam under clouds in which one can see million different animals and things with the right amount of imagination. In the ceiling LED lights move along with the child's finger on the tablet screen, fascinating patterns swirl and changes color. Through the double door in the middle of the dividing wall one enters into the relative's room, the door is large enough to keep the two rooms joined most of the day. The unit is roomy and can be accommodated to plenty of different furnishing and still leave plenty of space for the patient's treatments.





Ill. 174 Plan of the courtyard

The interior gardens is the building's gentle alternative to the surrounding forest. The garden's sheltered and cultivated. Circular form language is used throughout the garden.

The circular lines are chosen since it is a strict geometry that connects well with the ellipsoid enclosure. Along the edges terraces connects the garden with the interior functions, letting the building spill into the garden by using glass walls embedded with doors. On the terraces patients, relatives and visitors from the daycentre can relax when the weather allows it.

The interior garden has paved tile paths with wooden terraces and social areas; this makes movement in beds or wheel chairs unproblematic. Rubber paving covers the play areas. All of the individual areas are connected and level with the interior, seamlessly connecting the interior and exterior.
The zones within the garden are marked by changing materials and enclosures created by raised flower beds beds. The raised flower beds are the star of the garden, here flowers and plants fills the senses with colour and fragrances. The sensory perception of the patients are saturated and stimulated. The plants are chosen according to low maintenance and to keep the garden green the year round. In front of the daycentre are deciduous trees with high foliage to maintain the view through the garden, the trees shade the interior from direct sunlight in the summer and allows light to enter in the winter.

Niches exist within the raised flower beds where families that need more privacy can be together, the niches can also be the frame for larger social events like barbecues or bonfires.

The southern part of the garden is covered in rubber connected to the play area inside, here are play zones where both sports and regular child's play are encouraged.

In front of the orangerie, the gentle sound of flowing water emanates from a small fountain in the middle of a circular reflecting pool. The pool is shallow meaning it can be used for play by the children.
Outside the zones and terraces are grass. Along the edge drains collecting rain water contours the meeting between the garden and the building. This likewise prevents water damage to the façade.

Ill. 175: NORTH ELEVATION

Ill.176: EAST ELEVATION


Ill. 177 SOUTH ELEVATION


Ill. 178 WEST ELEVATION

Elevations in the scale 1:200 can be found in the attached drawing folder

Ill. 179 SECTION A

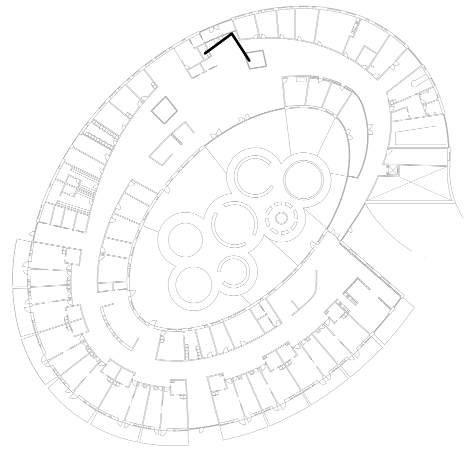
Ill. 180: SECTION B

Section in the scale 1:200 can be found in the attached drawing folder

Ill. 181: Visualization of the arrival /daycenter

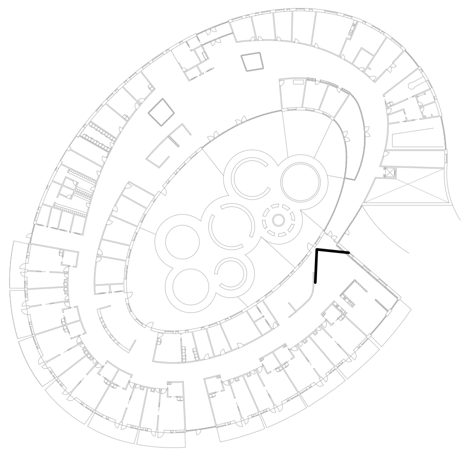
As the family drives through the forest the building slides into view among the trees. The family drives up to the drop off point with the extruded roof, and sees the arrival area fades into view through the glass façade. Two layers of glass protect the interior from wind and weather. As one passes through the double glass layers, a view of the lake through the entirety of the building complex becomes clearer. By lining up the entrance, glass walls to the courtyard in the daycenter and the glass passage connecting the two ends of the building, the boundaries between the building and the landscape disappears.
The arrival connects into the daycenter, which in turn connects with both the canteen, the hallways and the interior garden. A central core containing the reception, cantina kitchen and visitor bathrooms partitions the space. The hallway flow into the daycenter around two smaller interior gardens, that pulls in light and nature. Each garden holds a tree and minor plants, they are not puplicly accessible. The Families arrives into a smaller space that opens into a large, bright space overlooking the gardens and giving and overview of the entire interior volume.
The materials used here are white acoustic gypsum on the ceilings, and white painted gypsum walls with hydrocork flooring. All mullions are white oiled oak. There several built in bookcases all kept in wood.
The reception is a niche in the partitioning core, it is placed to the right of the arrivals and is hard to overlook. Signage will point the arrivals here. On the opposite wall a large blackboard features drawing and writing by the children in the house.

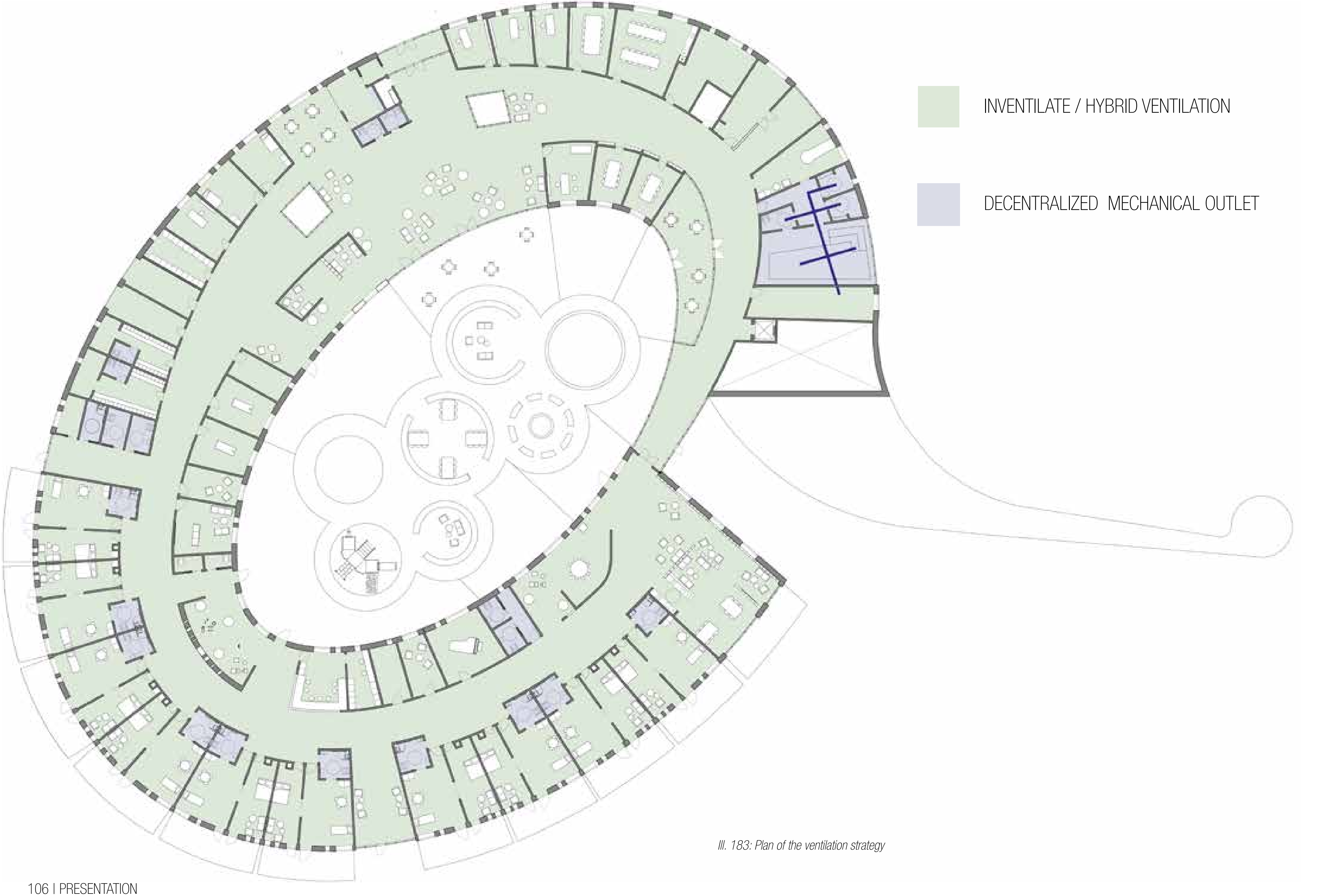
After signing in the arrivals will be lead into the daycenter. This where chronically ill patients come for shorter periods to receive palliative treatment. The daycenter lays opposite the patient units, and unlike their closed and private atmosphere the daycenter is open and facilitates life, creating connections between children going through the same struggles in life helps immensely in the palliative process.
The daycenter is filled with furniture and smaller partitions, to create more tangible spaces and niches. The open space is highly flexible, and holding larger events is possible in this area.
The cantina while directly connected to the daycenter as spatially separated by the core. Like the reception the kitchen and serving is in a niche. In the cantina one can eat both the served food or one's own. Table arrangements looking into the forest frames the places. If the weather allows it one can also chose to dine on connected terraces in the interior garden.



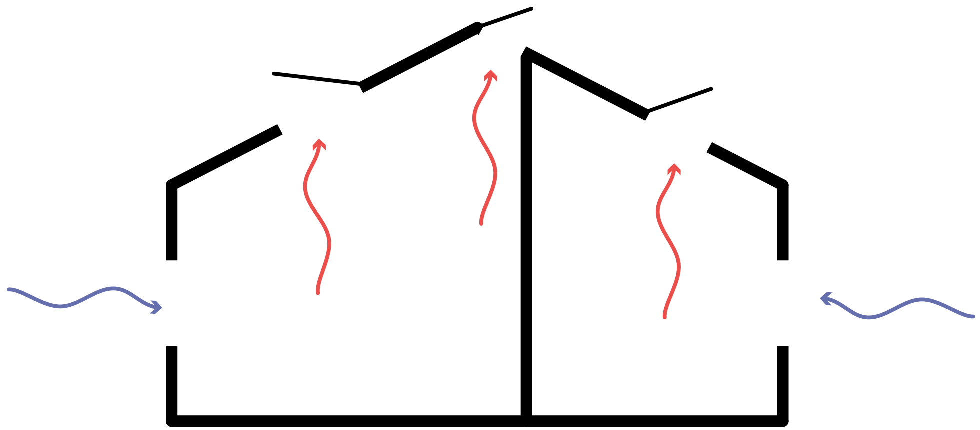
Ill. 182: Visualization of the common room

At the end of the patient unit section lays the common room. This is the gathering point for the patients and their relative, this where they can socialize by themselves or with other families.
The room serves all the patient units. It includes kitchen tops for cooking, dining area and different niches with varying levels of privacy. The major room separators are bookshelves containing books, games, plants and trinkets. The basic frame of the commonroom is large and open, the niches are created by furniture, and lamps hanging from the ceiling can be moved on rails allowing the furniture to be moved around at will, creating a flexible space, which is important in accommodating the varying needs of the inhabitants.
The room has hydrocork flooring like most of the patient functions and hallways in the building. The ceiling and walls are white acoustic gypsum. The monochrome walls and ceilings are meant to calm the form in a room that contains a multitude of shapes and colors from furniture, books, niches and flooring within it.
The eastern windowsills can be used for seating and creates small light niches inside the floor to the ceiling bookcase placed on the entire wall.
In this room experiences should be lively not filled with death. There are placed kitchen tops here instead of inside the units to force the families out of their rooms and move around. Cooking together as a family is important and sharing the meal in the dining area or on the terraces in the interior garden is indispensable. The fragrance from the cooking is a sensory impression used in palliative treatment. Many of the patients will be too ill to eat anything other than light foods, but the smells of a meal cooking is still something they can value.
In the common room there will be several aquariums, These have a calming effect on children and adults alike and experiences from “Lukashuset” shows that they can create bonding experiences for the inhabitants.
An important aspect of these functions is to frame the memories of the families last times together. Whether it’s playing board games in the summer nights while a soft breeze blow fragrances of fir and flowers through the open doors to the interior garden. On alternatively, huddling together in the couch looking out over the frozen waters a cold winter’s day.





Ill. 183: Plan of the ventilation strategy



Ill. 184: Diagram of the natural ventilation strategy

VENTILATION

All rooms and functions placed along the exterior façade are ventilated by a system called Inventilate. Inventilate is a pipeless and mechanical ventilation system that is installed in the exterior facade allowing for easy adaption to the buildings architectural design. Inventilate fits well in a children's hospice due to the high level of user comfort with intelligent and local control options, which helps avoiding discomfort in relation to indoor air quality and temperature.

Furthermore it fits the chosen roof and ceiling design allowing the high pitched ceiling to be undisturbed by large industrial looking ventilation pipes, or a flat ceiling solution.

The average patient room takes up 132 m3 and have an air chance rate of 4 times per hour, which equals 528 m3 of air every hour. The solution for each patient room, is a system consisting of four Inventilate units each with an air change rate of 144 m3/h.

Regarding energy consumption the Inventilate system uses 300 J/m3 and allows for a minimum of 85% heat recovery. A low energy consumption is increasingly becoming more and more important due to the toughen requirements regarding CO2 emission in BR15 and BR20.

In order to ventilate wetrooms, each room in outfitted with a decentralised aggregate that only works as an outlet. (Odense Universitetshospital, 2012)

Ill. 185: LED light in the ceilings (room-decorating-ideas.com, 2016)

Ill. 186: LED light in the ceilings (room-decorating-ideas.com, 2016)

CEILING

In the patient units the ceiling needs to be above functional. Most of the patients will spend a large amount of time bedridden; therefore, their point of view will be on the ceiling for long periods. The ceiling should be able to stimulate the bedridden children in these dull periods of their stay. (Pavi, 2016) (Hørlück, S. 2016)

The considered approaches to the design have been to workin form, materiality and light.

Working the surface materiality would be using the inherent texture and color of a material to create an engaging ceiling. The anisotropic nature of wood makes it an ideal candidate. Throughout the project, the materiality have been repeatedly considered and reconsidered. The conclusion in respect to the patient units were to keep the materials calm and unified, therefore the materials of the ceiling will not stand out from the remainder of the surfaces. The ceiling are cladded with white oiled acoustic wood panels.

Using the form to create an interesting ceiling, were mostly considered with different types of roof structure than the final gable roofs. The goal was to create shapes that would engage the patient.

Finally light have been the primary mover for the ceilings, both by utilizing daylight and openings, together with artificial light ornaments.

Daylight mainly enters the patient units from skylights, in the patient's room a singular skylight is placed directly above the patient's bed, opposing the patient a skylight stretches along the entire dividing wall. The rational is that while materials, colors and shapes, can be interesting and engaging they will be static, a view of the ever-changing sky will be more engaging over time than other solutions.

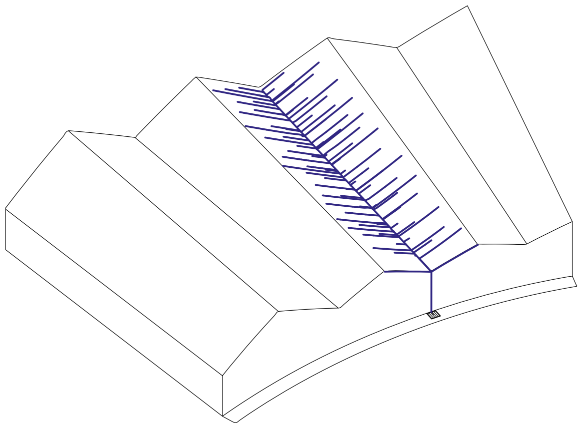
Small LED lights litter ceiling, connected to a controller accessible wirelessly from an application on a tablet or similar.

The LED light will create the feeling of a starry night sky. The solution is commonly used in palliative treatment in most children's hospices (Hørlück, S. 2016).

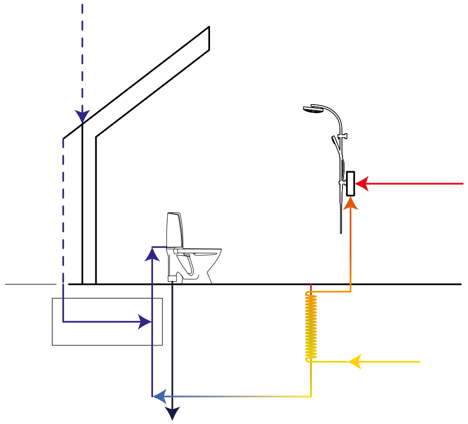
From the controller the child can change the color, intensity and composition of the light. Plenty of different solutions on the market deliver cheap customized lighting with the desired specifications.

The ability for the child to alter their environment by a few button presses is paramount in providing a feeling of agency. The ability to change color and intensity can increase the wellbeing of patients in pain. Persons under medical care by definition are limited in their agency, the disease and the medical routine controls them, the patient should therefore be given some degree of control over their environment. It is very fitting that the part of the environment they will spend a large amount of time looking at should be the place that the patient controls. (Pavi, 2016) (Frandsen, 2011)

The ceiling in the patient unit will stimulate the child by being dynamic and allows the child to engage its environment.



Ill. 187: Diagram illustrating how rain travels along the roof tops



Ill. 188: Diagram showing the utilization of rainwater

Ill. 189: Copper surface (Antimicrobial Copper, 2015).

RAINWATER STRATEGY

Leading rainwater away from the roof is an essential function to preventing structural damages due to dampness. While there are no fixed requirements for the roof angle it is generally recommended with a ratio of 1:40, but it is not necessary as long as the rainwater can be lead safely away. This is solved by raising the valley gutter 20 cm on the outward facing end compared to the end at the interior courtyard.

The double curved surfaces on the roof slopes in towards the courtyard, which makes the water run inwards before entering the valley gutter.

Once in the valley gutter it will be lead to gutters hidden within the cladding of the building. All gutter are in black zinc.

Water lead through the drainage will be stored in tanks and used as grey water in toilet flushing. Water in the interior gardens should be prevented from pooling and lead towards the same drain system.

Shower water will be added to the same grey water tanks. But will pass through a heat recovery system used by the shower to minimize the energy usage related to water heating.

Tanks should be able to hold large amounts of water, and if spillover should happen a strategy will be implemented to lead water away from the building.

BACTERIA AND VIRA

Minimizing the spread of diseases is important in any healthcare facility. A way to do so is by placing anti-bacterial surfaces such as cobber, silver or other anti-bacterial metals that can remove deposited bacteria and virus, in specific places such as kitchen counters, touch screens, handles, and the back of chairs.

Covers specially developed for smartphones, tablet and other touch-screens should be handed to patients, relatives and staff, besides giving instructions of daily cleaning with anti-bacterial wipes. (Hodges et al. 141-146) (Brady et al. 397-398) (Ramesh et al. 160-165)

Toilet doors should be equipped with hygiene instructions and only be able to unlock after activation of anti-bacterial foam dispenser, with the option of overriding the system if failure occurs. Faucets should be controlled by touch-free sensors, while toilets should be equipped with an aqua clean system. Both options insure better hygiene while increasing the level of independency for the patients.

INCORPORATING NATURE AND VIEWS

Choosing the site by pebermosen requires tact when making a building of this magnitude. The reason for choosing the site were for the natural qualities and calmness.

Drawing the qualities of the site into the building are essential.

A large portion of both the volumetric studies and plan development sought to open the building up to the nature surrounding it. A pillar in both healing architecture and palliative treatment are the view of nature. The human longing to experience the landscape they inhabit have shaped us throughout our history. It is a very basic feeling and one that is important to satisfy in any kind of building associated with the treatment of human beings. It is stress reducing and lessens the feeling of being "kept" in containment. (Healing architecture, PAVI)

Transparencies and blockades are used in the project, nature is revealed and framed creating shifting vistas as one moves around the building. The site slopes down towards pebermosen, on the other sides hills rise up dwarfing the building. The building sits on a small protrusion in landscape. Therefore, the building is elevated compared to the immediate surroundings on three fourths of the façade. Most of the views are therefore elevated.

When a new arrival enters the building, they have driven up at the drop off through the dense forest. Through the double glass door a vista of pebermosen is revealed through the light and open space of the daycenter and the interior garden. The view juxtaposes the wild nature surrounding the building with the very controlled and ordered sensory garden of the courtyard. As the arrival moves into the daycenter they are flanked by two interior gardens holding a tree each, the woods filter into the building volume.

As one starts to circulate around the building entería the hallway to the east, the building closes only allowing views through skylights. However, at intervals hallways open to exterior with curtain walls of glass. The interior garden reveals itself through punctures where the hallway flows into the interior ring of functions.

When one passes by the patient units and enters the common room nature opens up to all sides. Large cuts in the façade gives a vertical composition on the water below, the trees at level and the sky above. On the other side a glass wall opens into the interior garden. On a summer day where the doors are kept open flowery smells, buzzing of bees and singing of birds flow into the common room.

Connecting the common room with the orangery is a glass corridor that pulls the surrounding nature in and leaves little else of the building. The orangery connects into the corridor, here it is green whatever the season. From here one moves back into a hallway punctured by the departure, with its path of trees and bushes leading the departed away.

Inside the majority of functions nature is framed inside scattered windows of different sizes, with a beating rhythm of one large square and one tall narrow window through the entire façade. The small scattered windows creates small peeks into forest.

The basin room is an exception, a large window looks into the forest from an elevated, allowing the children to swim beside tree canopies.

Ill. 190: Tree from pebermosen


Ill. 191: Hydrocork (Wicanders Hydrocork, 2016)


Ill. 192: Texture care express (Egetæpper, 2015)


Ill. 193-A: Artigo rubber flooring (Artigo S.p.A, 2015)

MATERIALS

<u>Interior</u>

Flooring:

HydroCork: Main flooring placed everywhere with the exceptions listed below.

Texture Care Express Carpet (anti-bacterial): Meeting rooms, offices.

Tiles: Wet rooms

Artigo rubber floor: Play areas, thereapy.

Walls:

Gypsum plaster painted with white gloss 20:

Gypsum plaster painted with desaturated colours following the chosen colour of the floor: Play areas.

White oiled oak panels: Patient units

Tiles: Wet rooms

Ceilings:

Acoustic gypsum plaster painted with white gloss 10: Entire complex with the exceptions listed below.

Acoustic white oiled oak panels: Patient units

Wet room gypsum plaster painted with white gloss 25: Wet rooms

<u>Exterior</u>

Façade:

Kebony treated pine lamellas in varying sizes.

Terrace: Kebony treated pine boards in 28mm*142mm with an anti- slippery surface.

Access roads:

Permeable concrete

Roof:

Roofing felt

Photovoltaic cells in matte black

Pathways

Kebony treated pine boards in 28mm*142mm with an anti- slippery surface.

Ill. 193-B: Lamella cladding (Kuehnlein-architektur, 2014)

Ill. 194: Matte solar cells (Gaia Solar, 2016)

Ill. 195: Permable concrete

Ill. 196: White oiled oak panels (Mørk, 2011)

HydroCork: Sustainable cork floor with good durability, acoustic qualities and easy to clean. The 3d printed linoleum surface makes the product looks like a traditional oak floor. Suitable for floor heating. (Wicanders, 2014)

Texture Care Express Carpet (anti-bacterial): Carpet designed for use in hospital and other institutions with a high regard for hygiene. The carpet uses ÆGIS Microbe Shields Technology in order to prevent bacteria in the carpet. Suitable for floor heating. (Ege.dk, 2016)

Tiles: Mirage 300mm*600mm Italian tiles for the floor and walls. Suitable for floor heating. (Erhvervsgulve, 2016)

Artigo rubber floor: Durable rubber floors with a soft surface and good acoustic abilities. The colours yellow and orange are chosen for the play areas. Suitable for floor heating. (Erhvervsgulve, 2016)

Gypsum plaster (fire protecting abilities) painted white: Gyproc GFE 15 PROTECT F Ergo is fire protecting gypsum board, which helps to protect the main wooden construction in case of fire. When painted white, the surface add a certain calmness to space. (Gyproc.dk, 2016)

White oiled oak panels: Wood panels that adds a light and warm atmosphere to rooms. The light and discrete wooden texture fits well with the context of the forest.

Tiles: Italien mirage tiles that adds a lightness to the room, and compliments the homely atmosphere by being a familiar choice for the private residence.

Acoustic gypsum plaster painted with white gloss 10: Plays well with the white painted gypsum walls, and adds a wholeness and calm to the complex. The acoustic abilities of the product helps to improve the acoustical indoor climate.

Acoustic white oiled oak panels: Similar to the white oiled oak panel applied on the wall but with the bonus of having good acoustical absorbing abilities due to perforating wholes. This product helps to improve the acoustical indoor climate of the patient unit.

Wet room Gypsum plaster painted with white gloss 25: Water resistant gypsum board is applied as a base layer in wet zones.

Kebony treated pine lamellas in varying sizes placed vertically: FSC®-certified Pinus Sylvestris treated with a bio-based liquid in order to improved durability and lower maintenance. Patenting from a deep rich brown colour in a silver-grey look as a result of outdoor exposure. (Kebony.com, 2016)

Kebony treated pine boards in 28mm*142mm with an anti- slippery surface: FSC®-certified Pinus Sylvestris treated with a bio-based liquid in order to improve durability and lower maintenance. Patenting from a deep rich brown colour in a silver-grey look as a result of outdoor exposure. (Kebony.com, 2016)

Permeable concrete: NCC DrænStabil can optain 500 l/s/ha of water within 10 minutes, making the access road dry even during heavy rain. (NCC, 2016)

Roofing felt: An asphalt-based product that fits well to our double curved rood solution.

Photovoltaic cells in matte black: Gaia Solar Design Line, offers specially designed photovoltaic cells with custom shape and colour. In this case the choice is a monocrystalline panel with a matte black surface that blends well with the underlying roofing felt. (Gaiasolar.dk, 2016)

ENERGY FRAME

With the increasing demands from the Danish state to minimize the pollution, the Danish building regulation set certain demands for future buildings and their energy consumption.

The Danish energy frame of 2020 requires a energy demand less than 20 kWh/m^2 for detached houses and 25 kWh/m2 for other buildings. A Children's hospice is categorized as other buildings. To calculate the energy frame of a project the application Be 15 is used.

The main difference between detached house and other buildings is the lighting must also be part of the energy calculation for other buildings. (Aggerholm and Grau, 2014)

The hospice is 3658 m2 mainly built of wood giving it a heating capacity of 40 Wh/K m2, which means the building has a low thermal mass, which have positive and negative effects depending on the situation. (Aggerholm and Grau, 2014)

Low thermal mass, means the mass is quickly heated but quickly cools again if it isn't exposed to heating consistently. This means during the heating season it requires more heating than a building with a high thermal mass. This can however be solved by using intelligent passive solar gains and renewable energy. During the summer period the low thermal mass quickly cools during night, where as the opposite happens with high thermal mass which cause issues with overheating, and therefore requires high amounts of cooling, which is harder to produce sustainably.

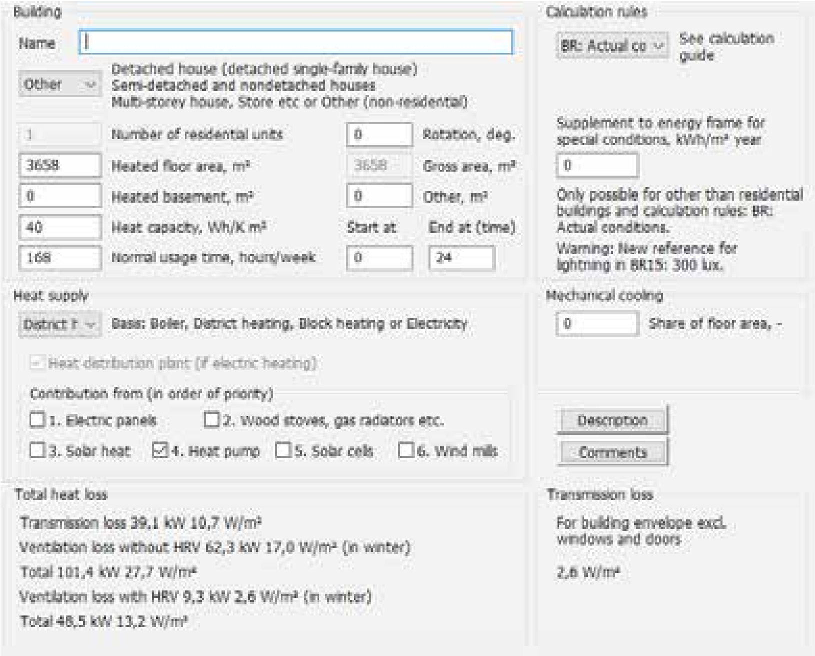
The shape of the building results in less surface area compared to a square building and removes corner connections that in combination with the thick envelope secures a total transmission loss of 2,6 kWh/m2 where as the demand from the building regulations is 3,7 kWh/m2 for one story buildings. Using high energy efficient windows minimizes transmission loss through the glazing and windows frame, by using Rationel Aura+ each window gets an u-value of 0,78 for the glazing and frame combined, furthermore this also results in a lower solar transmittance which is the G-value which is 0,51. The windows are optimized for passive sola radiation although too much solar radiation can result in over heating therefore outdoor shading must accommodate the demands of the energy frame, in this case this comes both as a mechanized outdoor curtain and passive shading from nearby trees.

The building is ventilated by hybrid ventilation, meaning a combination between natural ventilation and mechanical ventilation, which comes in the form of the product Inventilate which removes the need for ventilation ducts, and can be manipulated specifically for each room. The Danish building regulation states that the minimum requirement for ventilation is 3 l/s per child, 5 l/s per adult and 0,35 l/s m2. With around 60 people being present in the building that gives around 0,43 l/s m2 for the whole building to fufill the requirements. For more optimized and specific data on ventilation look in the detailed section about units/bsim.

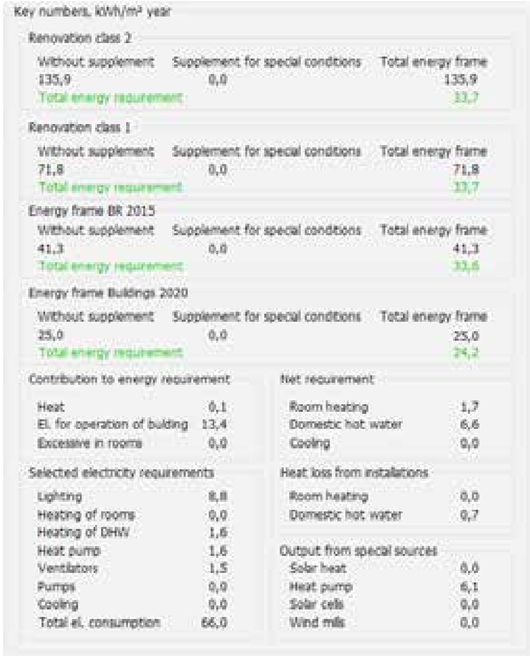
With the building being in a remote area and off the heating grid requires is to produce it's own heating, a substantial part of the heating is gained by passive solar radiation. Using a brine to water pump placed vertically results in efficient and renewable heating for the building while also minimizing the impact on the surrounding environment.

With these solutions the buildings energy requirement is 24,2 kWh/m2 meaning it fulfill the Danish building regulations for 2020. Looking at the energy needs for the building heating is set at 0,1 kWh/m2 and electricity at 13,4 kWh/m2 these numbers are not listed in primary energy which the total energy requirement is, therefore different factors must be added to each value.

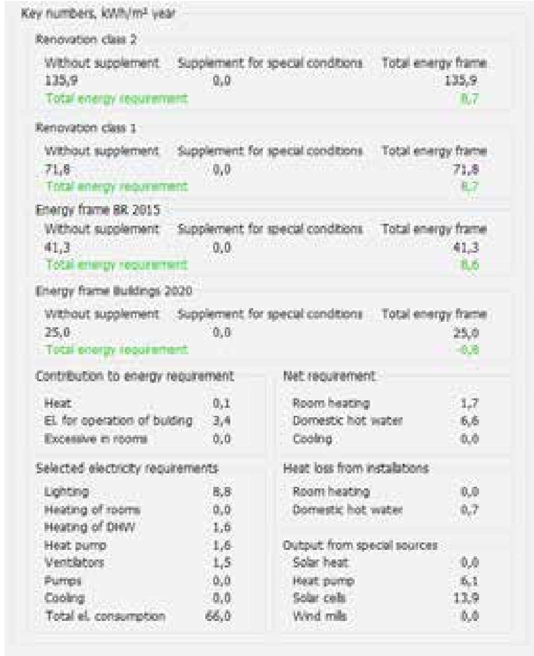
With heating a factor of 0,8 is added to the 0,1 kWh/m2, the factor is determined by how it's produced in the near future, with the factor being 0,8 means heating is produced with less energy loss and more sustainable. (Aggerholm and Grau, 2014)



Ill. 197: BE15 configurations showing the low transmission loss of 2,6 W/m²



Ill. 198: Key numbers without solar cells



Ill. 199: Key numbers with solar cells

For electricity a factor of 1,8 is added to the 13,4 kWh/m2, because of the loss from transformers at the power facility.

The sum of Heating and Electricity equals 24,2 kWh/m2 in primary energy.

This means that 99,67% of the energy demand is electricity, which can be covered sustainable by photovoltaic cells.

Using monocrystalline cells integrated with the roofing felt and optimized placement gives high efficiency. A total of 165 m2 is enough to cover that demand on a yearly basis meaning that the building produces enough energy to cover the electricity usage it uses from the power grid, when the cells is not producing electricity, an example would be during night.

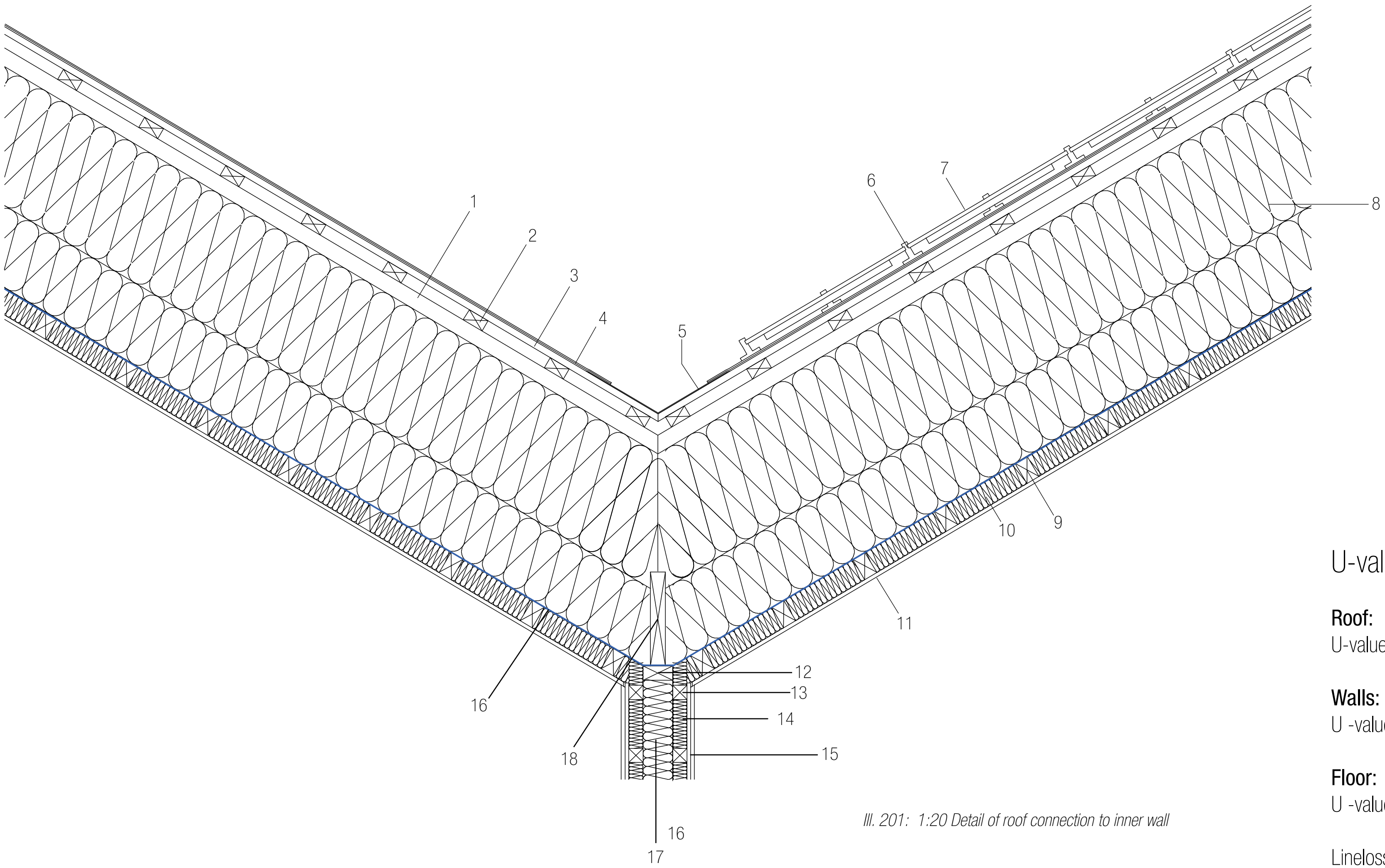
This equal a building that meets the requirement of a zero energy site building.

The energy consumption is only for running the building and does not include the energy for appliances as the value is hard to determine as different factors affects it. An example would be new more energyefficient equipment and the number people present in the building at certain times.

Photo Voltaics Calculation

Calculation of area of Photovoltaics				
Energy Frame 2020 (Be15)	13,4 kwh/m2			
Heated area	3658 m2			
Needed Energy Production pr. Year (Primary)	49017,2 kWh		*(13,42*3658)*1,8)*	
Area of photovoltaics needed	**164,158** m2		*(F/(E*D*B*1,8))*100*	
A. Area of Module:	164,158 m2		**D. System factor**	0,8
B. Effiency of Module	18		**E. Yearly solar gains**	1152 kWh/m2
C. Installed Effect	29,5484 kWpeak		**F. Yearly Production**	49017,3 kWh

Ill. 200: Photovoltaic calculation



Ill. 201: 1:20 Detail of roof connection to inner wall

1	Ventilated space
2	38x72mm Lath
3	22mm Plywood sheating
4	Roofing felt
5	Zinc valley gutter (black)
6	Lock for solar cells
7	Monocrystaline cells in matte black
8	600mm Insulation
9	70x45mm Batten
10	70mm Insulation
11	12mm Acoustic gypsum board
12	45x95mm Top framing
13	45x45mm Batten
14	45mm Insulation
15	2x 12mm Gypsum board
16	Vapor barrier
17	95mm Insulation
18	50x300mm Gluelamminated timber

U-values & Lineloss

Roof:
U-value 0,6 W/m^{2}K (Rockwool, 2016)

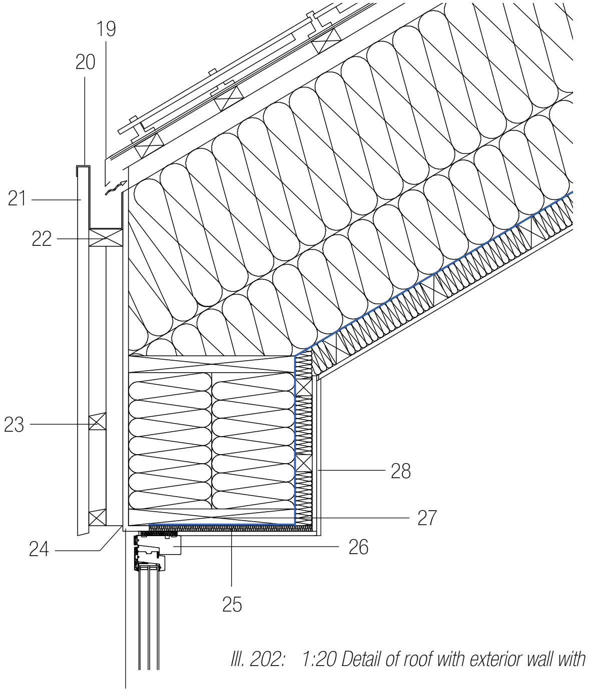
Walls:
U -value 0,8 W/m^{2}K (Rockwool, 2016)

Floor:
U -value 0,8 W/m^{2}K (Rockwool, 2016)

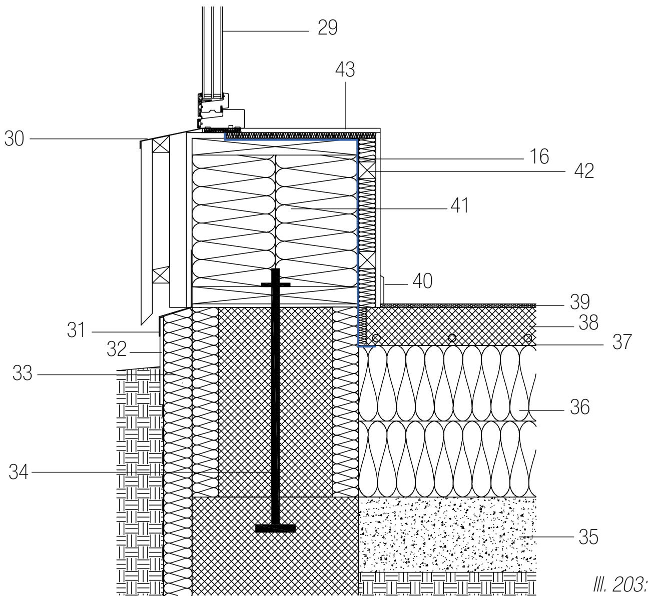
Lineloss 0,06 W/mK (Beregning af bygningers varmetab, 2011)

Windows:
U-Value 0,78 W/m^{2}K (Rationel, 2016)

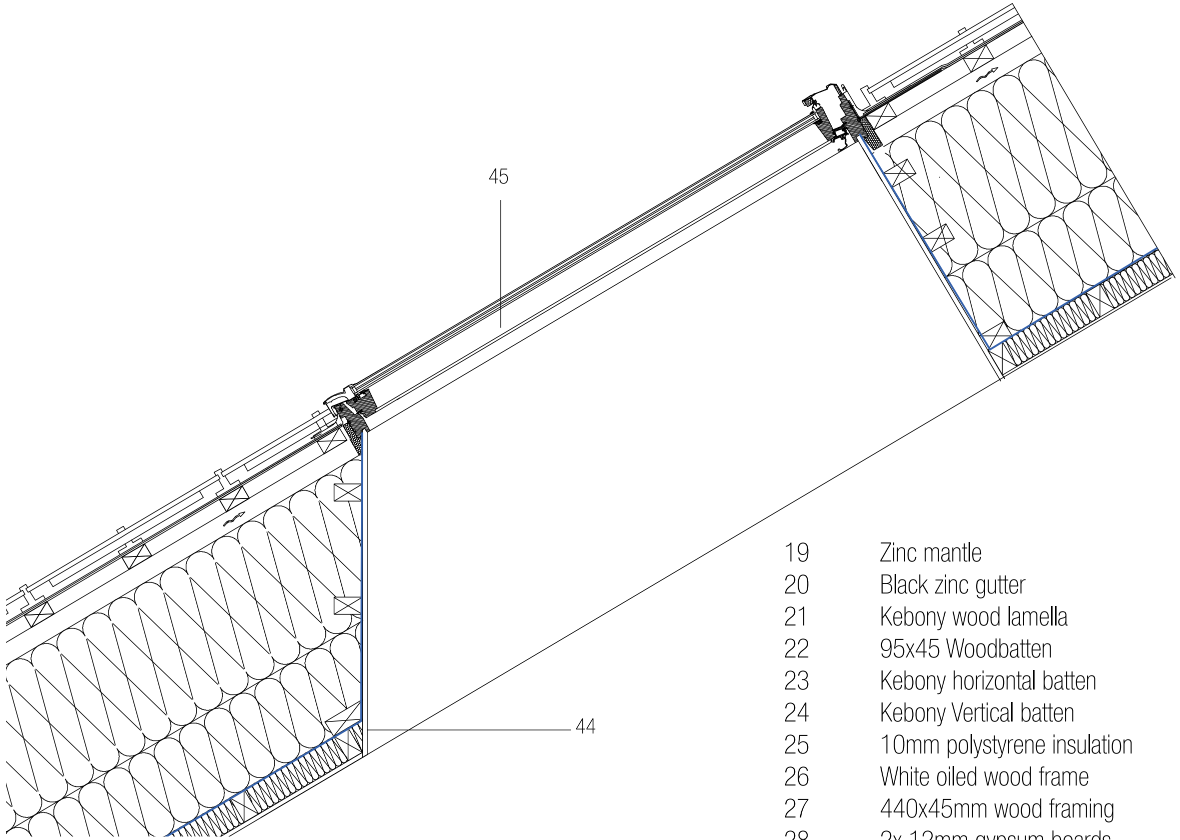
Lineloss 0,06 W/mk (Beregning af bygningers varmetab, 2011)



Ill. 202: 1:20 Detail of roof with exterior wall with window

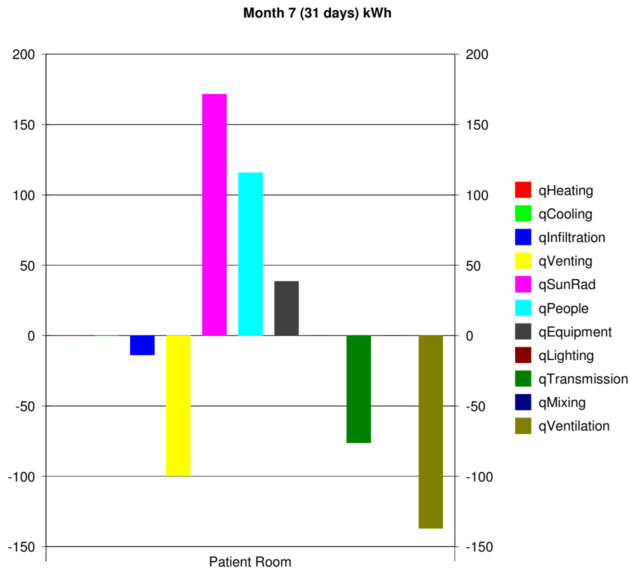


Ill. 203: 1:20 Detail exterior connection with flooring and terain

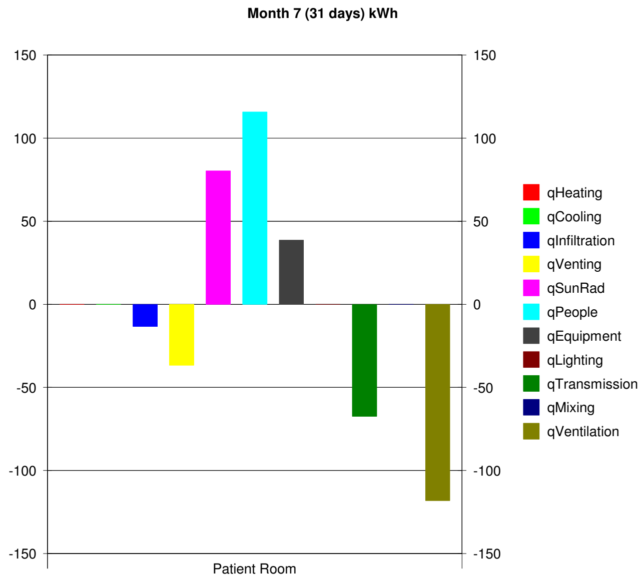


Ill. 204: 1:20 Detail of roof with skylight

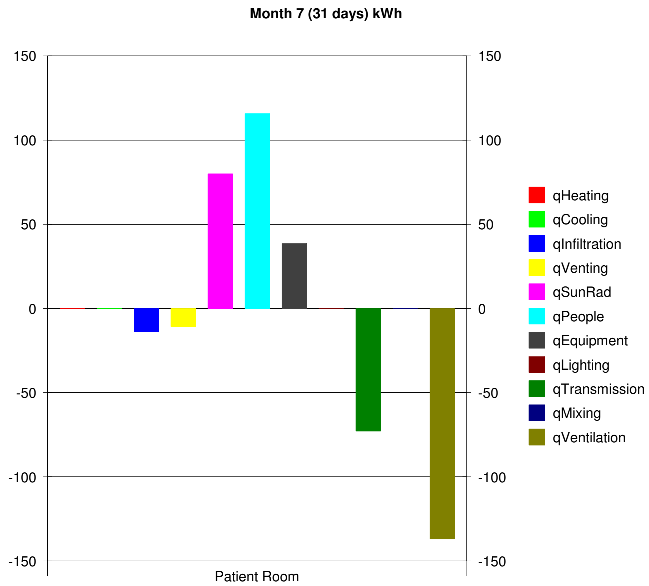
19	Zinc mantle
20	Black zinc gutter
21	Kebony wood lamella
22	95x45 Woodbatten
23	Kebony horizontal batten
24	Kebony Vertical batten
25	10mm polystyrene insulation
26	White oiled wood frame
27	440x45mm wood framing
28	2x 12mm gypsum boards
29	Rationel Aura PLUS 3 layered
30	Zinc mantle
31	Zinc mantle
32	Plinth plaster
33	150mm Polystyrene
34	Anchorage
35	200mm Leca Nuts
36	400mm Polystyrene
37	Building paper
38	Concrete with floor heating
39	8mm Cork flooring (Hydrocork)
40	15x70mm Wall base
41	440mm insulation
42	45x45 batten
43	White oiled oak extension jamb
44	12mm gypsum board
45	Velux Skylight



Ill. 205: Bsim analysis with no shading



Ill. 206: Bsim analysis with 0,3 shading



Ill. 207: Bsim analysis without natural ventilation

BSim Calculations:

The bsim calculations are made for what is considered the most critical rooms. These are a patient unit facing south, a patient unit facing west and a meeting room facing south.

Considering the palliative treatment the inhabitants undergo, the indoor climate in patient unit affect the children's wellbeing greatly. The climate should be flexible which the chosen solutions like inventilate support, while the baseline climate should be tolerable.

The temperature is around 21 degrees, which is normal living room temperature.

The patient unit is calculated as three separate thermal zones. The patient room, the relatives room and the bathroom.

The people load in the rooms are set to 3 max for the patient room, 2 max for the relatives room and 2 max for the bathroom.

The schedule for the rooms assume most people in the morning and evening to simulate the staff making rounds and the family being together. During the middle of the day one person is calculated in each room, assuming people spend their time around the hospice but few may be too ill and stay in the room. People load in night is lowered to account for the lower MET of sleeping people.

Heating comes from floor heating aiming for the 21 degrees centigrade in the heating season (middle of may to middle of September). To account for low temperatures heating is turned on in the night on week 20-24 and 38 from 24 – 3 a clock.

Ventilation is calculated as VAV with 0,85 heat recovery, and no heating or cooling system. The air change rate is calculated from "Tekniske standarder, Vejledende luftskifter og lydtryksniveauer" (Odense Universitetshospital, 2012) and divided by 3, max factor on the VAV system is accordingly set to 3. Gearing the system with inlet control leads to massive heat loss.

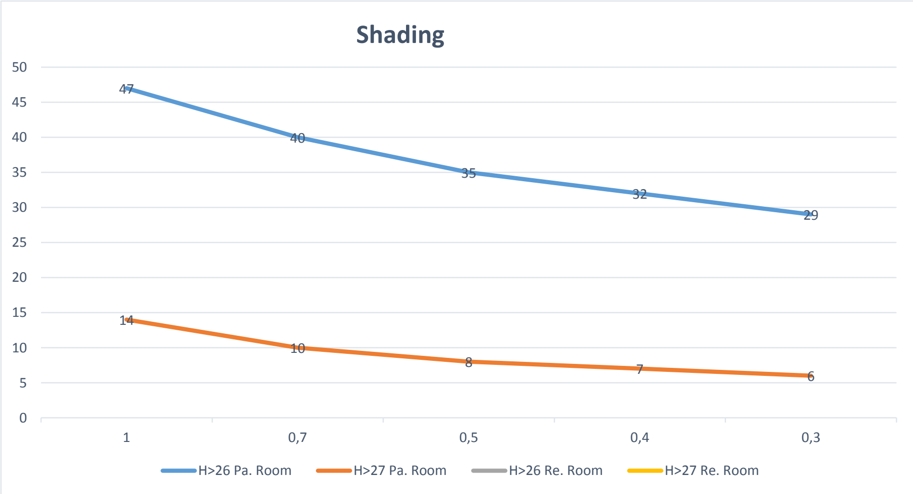
Doors both interior and exterior has an afrac value of 1, large windows has a value of 0,75 and skylights 0,2. All windows and outer doors have a continues exterior shading system with a shading value of 0,3. The exterior doors have an overhang of 0,5 meters to prevent overheating. The smaller windows in the facade shade too but have an afrac value of 0, since they are assumed a bother to open and close at will.

Equipment load is set at standard value, since that is assumed to be high enough. Most of the stationary equipment are electronics like tablets, laptops, game consoles and TVs. While the heavier medical equipment will be either mobile or different from patient to patient. This is not reliable to take into account, and may skewer results undesirably since the most likely problems stem from cold not heat.

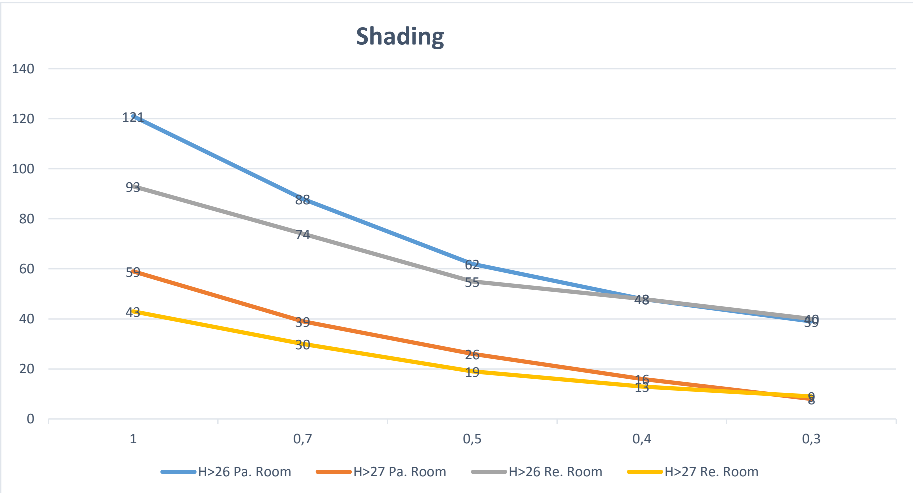
The calculations on both patient units reach well within the frame, registering singular drops into the high 19 degrees at night in early May. This is easily solved by heating when needed, it was deemed acceptable in the bsim model for this reason.

The meeting room was chosen because it is an exposed room with spikes of larger groups of people. The parameters are mostly the same as the patient units, with the ventilation dimensioned accordingly.

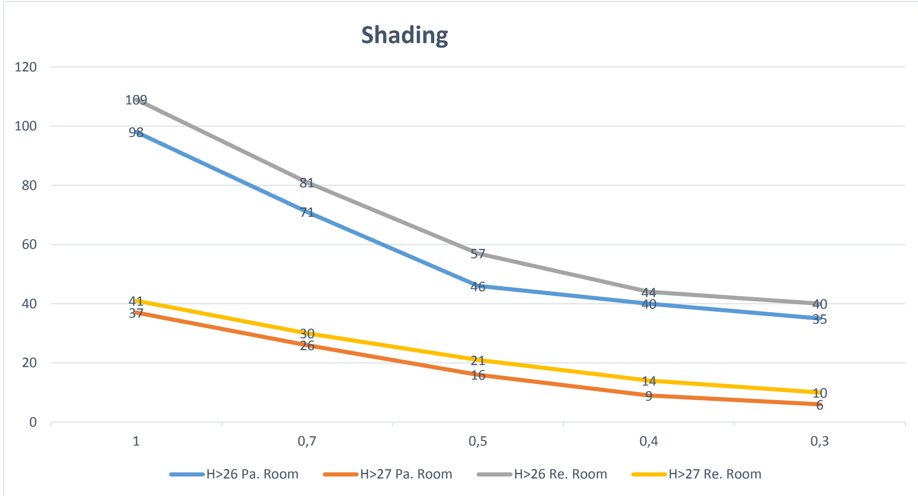
The people load are very different. The maximum amount of people are 10 which is reached at the morning conference in the weekdays the remainder of the day the load is between one and two people simulating smaller meetings or people doing registrations in the room. At the end of the day another load spike simulates conversations with families or medium sized meetings.



Ill. 208: Bsim analysis showing shading factor compared to the amount of hours above 26 and 27 degrees for the meeting room



Ill. 209: Bsim analysis showing shading factor compared to the amount of hours above 26 and 27 degrees for patient unit facing west



Ill. 210: Bsim analysis showing shading factor compared to the amount of hours above 26 and 27 degrees for the patient units facing south

CONCLUSION

Through the use of IDP this project aimed for a sustainable children's hospice that were able to facilitate a last stop for terminal ill children in a dignifying manner. Through the guidelines of healing- and palliative architecture, this project utilize the natural qualities of Hammer Bakker in order to create a hospice where functions and aesthetics goes hand in hand. The design is shaped with respect for the context, and places functions according to the existing elements of the site.
Arrival and offices is placed facing north to use the existing paths leading to the site and to use the natural qualities of the northern light. Common rooms and patient units are placed in a more private section taking advantage of lower people traffic as well as the stress relieving view of the lake.

A homely atmosphere and patient agency are key elements throughout the entire design, in order to give both patients and relatives a comfortable time without depriving the patients of their dignity. Units are designed to accommodate the modern family structure, so that they are more likely to participate in the daily routines related to the palliative treatment of the patient. Common rooms are designed with focus on encouraging relatives and patients across family borders to socially interact and harvest the benefits of sharing information and giving and receiving support.

The design also takes the differing needs into consideration concerning the age span from 0- 18 year old patients and their varying conditions, as well as heathy relatives. A variety of sensory stimuli, and age divided functions insures that patients and relative can play, relax or withdraw according to their own personal needs.

The hospice focuses on sustainability through the use of materials as kebony treated soft wood, cork floors, reuse of rain water and a wooden construction. Also by using intelligent and sustainable solutions to fulfill the 2020 energy demands with a key number of 24.2 kwh/m^2 a year, and a comfortable indoor climate tested in Bsim.

REFLECTION

The major challenge of the project consist of the emotional aspect in designing a children's hospice combined with the complexity of dealing with a rather wide user group within a narrow field.

After visiting the Sankt Lukas children's hospice it was clear to us that the only way to approach this extremely sensitive topic was by letting death become a natural part of the design, but at the same time having life as the dominating factor. The mantra for the project quickly became "the dying are still living".
A homely atmosphere, dignity and agency was key elements from start to finish and became the dominating design criterias alongside neuro aesthetics parameters for the creation of s
pace and sustainability.

The end result is a building that through the design, materials and choice of site offers palliative care for terminal ill patients and their relatives in a homely atmosphere. The design allows for healthy social interaction through common rooms, where patients and relatives can harvest support, and share information, grief or happy and joyful moments. Age defined functions facilitates play, gaming, relaxation, or withdrawal for both the patients and heathy relatives. The calm and natural stress relieving surroundings consisting of the ever changing colors and sound of the forest, alongside the view of the lake, offers an endless source of joy and fascination for both children, teenagers and adults.

On the technical aspects, the use of BE10, Bsim, grasshopper, LadyBug and HoneyBee insured a well-integrated design process that left only minor adjustments for the final design to reach the 2020 energy demand.

Topics for further development.

Arguably we could have visited more children's hospices than Sankt Lukashuset in Gentofte, to collect on-site impressions on design, daily workflow and choice and tactility of materials and furniture. Unfortunately this was possible due to lack of receiving funds in time.

Designing a multicultural reflection room on a detailed level, is a massive study in itself. It is by far the most complex room in the design, and demands a thorough study in order to truly understand how to design such a function without the chance of offending or discriminating any type of culture.

If time was available it could have been spend choosing specific products for furniture, kitchen, toilet, sinks, faucets etc.

It could all so be interesting to spend time developing a detailed interface for the controllers that control the indoor climate of the patient units.

On the exterior more time could be spend on further development of the interior courtyard, and the surrounding path systems in order to create a more sensory experience.

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APPENDIX

Reverbation Time for daycenter														
Surfaces	**Materials**	**Areal**	**125 Hz**		**250 Hz**		**500Hz**		**1000Hz**		**2000Hz**		**4000 Hz**	
		S(m^2)	α	Sα	α	Sα	α	Sα	α	Sα	α	Sα	α	Sα
Floor	Hydrocork	332,5	0,02	6,65	0,03	9,975	0,03	9,975	0,03	9,975	0,03	9,975	0,02	6,65
Curtain wall	Glass+frame	165,7	0,35	57,995	0,25	41,425	0,18	29,826	0,12	19,884	0,07	11,599	0,04	6,628
Ceiling	gipstone	545,45	0,35	190,9075	0,45	245,4525	0,55	299,9975	0,55	299,9975	0,4	218,18	0,45	245,4525
Innerwalls	gypsum	132	0,55	72,6	0,14	18,48	0,08	10,56	0,04	5,28	0,12	15,84	0,11	14,52
Exterior Walls	gypsum	26	0,55	14,3	0,14	3,64	0,08	2,08	0,04	1,04	0,12	3,12	0,11	2,86
Open area	0.75 absorbing coid	34	0,75	25,5	0,75	25,5	0,75	25,5	0,75	25,5	0,75	25,5	0,75	25,5
Windows	Glass+Frame	7,5	0,35	2,625	0,25	1,875	0,18	1,35	0,12	0,9	0,07	0,525	0,04	0,3
Doors	2,10*2,10	15,538	0,1	1,5538	0,07	1,08766	0,05	0,7769	0,04	0,62152	0,04	0,62152	0,04	0,62152
Absorption from Persons		**Antal**	**Sα/stk**	**Sα**	**Sα/stk**	**Sα**	**Sα/stk**	**Sα**	**Sα/stk**	**Sα**	**Sα/stk**	**Sα**	**Sa/stk**	**Sα**
Person		20	0	0	0	0	0	0	0	0	0	0	0	0
Chairs		30	0	0	0	0	0	0	0	0	0	0	0	0
Absorption in air														
v/ 50% RF		**Volumen**	**125 Hz**		**250 Hz**		**500Hz**		**1000Hz**		**2000Hz**		**4000 Hz**	
		[m3]	m	mV	m	mV	m	mV	m	mV	m	mV	m	mV
		2000					0,0004	0,8	0,001	2	0,0024	4,8	0,0061	12,2
Total absorption area, A [m^2]				372,1	2,1	347,4	1,9	380,1	1,7	363,2	1,6	285,4	1,6	302,5
Reverbation Time, T [sec		T=(0,16*V)/((Σα*s)+(Σn*A)+(4*m*V		**0,9**		**0,9**		**0,8**		**0,9**		**1,1**		**1,1**

Ill. 211: Showing the reverbation time for the daycenter

Reverbation time for Patient Unit															
Surfaces	**Materials**		**Area**	**125 Hz**		**250 Hz**		**500Hz**		**1000Hz**		**2000Hz**		**4000 Hz**	
			S(m^2)	α	Sα	α	Sα	α	Sα	α	Sα	α	Sα	α	Sα
Floor	Hydrocork		36	0,02	0,72	0,03	1,08	0,03	1,08	0,03	1,08	0,03	1,08	0,02	0,72
Ceiling	Wooden sheets		70	0,28	19,6	0,22	15,4	0,17	11,9	0,09	6,3	0,1	7	0,11	7,7
Wall/windows	Wooden sheets		90	0,28	25,2	0,22	19,8	0,17	15,3	0,09	8,1	0,1	9	0,11	9,9
51,81 m^2															
Windows			12,5915	0,35	4,407025	0,25	3,147875	0,18	2,26647	0,12	1,51098	0,07	0,881405	0,04	0,50366
Doors	2,10*2,10		5	0,1	0,5	0,07	0,35	0,05	0,25	0,04	0,2	0,04	0,2	0,04	0,2
Absorption from persons			**Amount**	**Sα/stk**	**Sα**	**Sα/stk**	**Sα**	**Sα/stk**	**Sα**	**Sα/stk**	**Sα**	**Sα/stk**	**Sα**	**Sa/stk**	**Sα**
Persons			0	0	0	0	0	0	0	0	0	0	0	0	0
Chairs			0	0	0	0	0	0	0	0	0	0	0	0	0
Absorption in air															
v/ 50% RF			**Volume**	**125 Hz**		**250 Hz**		**500Hz**		**1000Hz**		**2000Hz**		**4000 Hz**	
			[m3]	m	mV	m	mV	m	mV	m	mV	m	mV	m	mV
			69,03					0,0004	0,027612	0,001	0,06903	0,0024	0,165672	0,0061	0,421083
Total absorption area, A [m2]					50,4	0,8	39,8	0,6	30,8	0,4	17,2	0,3	18,2	0,3	19,0
Reverbation Time, T [sec	T=(0,16*V)/((Σα*s)+(Σn*A)+(4*m*V				**0,2**		**0,3**		**0,4**		**0,6**		**0,6**		**0,6**

Ill. 212: Showing the reverbation time for the patient unit

2014 | Month | Hours | Meeting Room

Meeting Roo	Sum/Mean	1 (31 days)	2 (28 days)	3 (31 days)	4 (30 days)	5 (31 days)	6 (30 days)	7 (31 days)	8 (31 days)	9 (30 days)	10 (31 days)	11 (30 days)	12 (31 days)
qHeating	5202,29	806,72	692,51	719,67	585,16	263,81	73,90	0,00	0,00	197,83	506,50	634,81	721,37
qCooling	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qInfiltration	-318,48	-41,59	-37,86	-44,04	-28,55	-20,44	-14,91	-9,38	-9,03	-14,12	-23,68	-34,33	-40,54
qVenting	-28,19	0,00	0,00	0,00	0,00	-0,93	-4,83	-12,56	-8,05	-1,82	0,00	0,00	0,00
qSunRad	376,59	12,32	21,11	37,37	41,93	46,47	43,30	38,87	37,56	39,11	31,51	16,61	10,41
qPeople	962,85	84,15	73,80	78,45	80,70	81,30	77,85	84,15	78,45	80,70	84,15	75,00	84,15
qEquipment	454,43	38,60	34,86	38,60	37,35	38,60	37,35	38,60	38,60	37,35	38,60	37,35	38,60
qLighting	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qTransmissio	-3039,43	-427,93	-351,21	-339,94	-204,72	-128,73	-87,87	-69,95	-95,77	-178,95	-302,54	-395,10	-456,72
qMixing	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qVentilation	-3609,80	-472,26	-433,22	-490,10	-511,87	-280,07	-124,65	-69,59	-41,77	-160,11	-334,54	-334,35	-357,27
Sum	0,25	0,00	-0,00	0,00	-0,00	-0,00	0,13	0,13	-0,01	0,00	0,00	-0,00	-0,00
tOutdoor me	8,1	0,7	0,4	-0,7	7,1	11,5	14,2	17,8	17,9	14,5	9,8	3,4	0,7
tOp mean(°C	22,8	23,0	23,0	23,0	23,0	22,7	22,7	23,0	22,8	22,5	22,8	22,4	22,2
AirChange(/	5,2	4,9	4,9	4,9	4,9	4,9	5,5	6,9	6,4	5,1	4,9	4,9	4,9
Rel. Moistur	36,5	22,5	22,5	20,3	29,0	38,3	48,6	56,0	54,5	49,3	41,5	29,4	25,6
Co2(ppm)	415,0	412,3	410,3	407,9	411,9	410,8	430,0	430,3	417,6	418,8	411,9	406,8	412,0
PAQ(-)	0,4	0,6	0,6	0,6	0,5	0,4	0,2	0,1	0,1	0,2	0,3	0,5	0,6
Hours > 21	8625	744	672	744	720	722	716	744	704	651	744	720	744
Hours > 26	29	0	0	0	0	0	0	16	10	3	0	0	0
Hours > 27	6	0	0	0	0	0	0	5	1	0	0	0	0
Hours < 20	16	0	0	0	0	0	0	0	5	11	0	0	0
FanPow	1990,67	159,43	144,00	159,43	154,29	159,74	169,50	210,67	200,42	160,05	159,43	154,29	159,43
HtRec	11224,64	1487,26	1350,69	1588,46	817,87	658,41	552,51	343,82	346,57	478,59	759,38	1281,01	1560,07
ClRec	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
HtCoil	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
ClCoil	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Humidif	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
FloorHeat	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
FloorCool	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
CentHeatPu	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
CentCooling	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
CentHeatPu	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
CentCooling	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00

Ill. 213: Values from bsim pr month for the meeting room

2014 | Month | Hours | Bathroom

Bathroom	Sum/Mean	1 (31 days)	2 (28 days)	3 (31 days)	4 (30 days)	5 (31 days)	6 (30 days)	7 (31 days)	8 (31 days)	9 (30 days)	10 (31 days)	11 (30 days)	12 (31 days)
qHeating	243,42	39,04	33,94	36,41	18,98	1,54	0,00	0,00	0,00	4,60	25,66	37,84	45,42
qCooling	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qInfiltration	-88,11	-11,67	-10,64	-12,45	-7,75	-5,52	-3,95	-2,56	-2,48	-3,66	-6,29	-9,62	-11,52
qVenting	-7,74	0,00	0,00	0,00	0,00	0,00	-0,74	-3,17	-3,55	-0,28	0,00	0,00	0,00
qSunRad	62,00	1,79	3,12	6,11	7,75	8,80	7,89	6,51	5,94	5,91	4,43	2,20	1,56
qPeople	438,00	37,20	33,60	37,20	36,00	37,20	36,00	37,20	37,20	36,00	37,20	36,00	37,20
qEquipment	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qLighting	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qTransmissio	-235,40	-25,12	-22,85	-26,15	-15,16	-15,60	-13,80	-10,38	-10,73	-13,43	-21,48	-28,02	-32,69
qMixing	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qVentilation	-413,00	-41,24	-37,17	-41,12	-39,82	-26,42	-25,43	-27,81	-26,98	-29,13	-39,52	-38,39	-39,96
Sum	-0,82	-0,00	0,00	-0,00	0,00	-0,00	-0,03	-0,20	-0,59	-0,00	-0,00	0,00	0,00
tOutdoor me	8,1	0,7	0,4	-0,7	7,1	11,5	14,2	17,8	17,9	14,5	9,8	3,4	0,7
tOp mean(°C	21,3	21,0	21,0	21,0	21,0	21,2	21,5	22,4	22,4	21,3	21,0	21,0	21,0
AirChange(/	1,8	1,5	1,5	1,5	1,5	1,5	1,9	2,6	3,1	1,8	1,5	1,5	1,5
Rel. Moistur	44,3	31,5	31,6	29,3	37,9	46,9	56,5	61,1	59,2	56,8	50,4	37,5	33,2
Co2(ppm)	627,5	635,5	634,9	634,8	636,6	634,1	619,6	606,3	604,2	622,9	634,3	633,1	634,2
PAQ(-)	0,4	0,6	0,6	0,6	0,5	0,4	0,2	0,1	0,1	0,2	0,3	0,5	0,5
Hours > 21	2316	0	0	0	64	238	367	692	667	288	0	0	0
Hours > 26	29	0	0	0	0	0	0	15	11	3	0	0	0
Hours > 27	4	0	0	0	0	0	0	4	0	0	0	0	0
Hours < 20	0	0	0	0	0	0	0	0	0	0	0	0	0
FanPow	175,94	14,37	12,98	14,37	13,90	14,37	14,54	17,37	17,18	14,23	14,37	13,90	14,37
HtRec	819,33	124,36	113,87	135,92	68,62	49,50	27,88	5,71	5,26	19,75	47,47	97,49	123,50
ClRec	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
HtCoil	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
ClCoil	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Humidif	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
FloorHeat	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
FloorCool	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
CentHeatPu	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
CentCooling	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
CentHeatPu	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
CentCooling	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00

Ill. 214: Values from bsim pr month for the bathroom in patient unit orientated south

2014 | Month | Hours | Patient Room

Patient Roo	Sum/Mean	1 (31 days)	2 (28 days)	3 (31 days)	4 (30 days)	5 (31 days)	6 (30 days)	7 (31 days)	8 (31 days)	9 (30 days)	10 (31 days)	11 (30 days)	12 (31 days)
qHeating	1682,19	322,32	273,35	298,34	103,27	24,78	8,60	0,00	0,00	6,33	72,64	238,18	334,39
qCooling	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qInfiltration	-473,25	-63,14	-57,56	-67,34	-41,92	-29,32	-20,94	-13,26	-12,89	-19,54	-33,76	-51,70	-61,87
qVenting	-84,34	0,00	0,00	0,00	0,00	0,00	-8,84	-36,73	-36,55	-2,22	0,00	0,00	0,00
qSunRad	829,24	26,38	46,05	82,97	101,99	110,23	97,50	80,32	75,53	83,24	67,78	35,08	22,18
qPeople	1363,27	115,79	104,58	115,79	112,05	115,79	112,05	115,79	115,79	112,05	115,79	112,05	115,79
qEquipment	454,43	38,60	34,86	38,60	37,35	38,60	37,35	38,60	38,60	37,35	38,60	37,35	38,60
qLighting	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qTransmissic	-2669,17	-353,10	-321,32	-372,17	-224,71	-159,79	-119,44	-67,41	-67,87	-114,38	-200,27	-303,95	-364,74
qMixing	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qVentilation	-1105,31	-86,82	-79,93	-96,17	-88,02	-100,26	-106,58	-118,17	-114,55	-102,81	-60,73	-66,97	-84,30
Sum	-2,92	0,02	0,02	0,01	0,02	0,01	-0,30	-0,87	-1,96	0,01	0,03	0,04	0,03
tOutdoor me	8,1	0,7	0,4	-0,7	7,1	11,5	14,2	17,8	17,9	14,5	9,8	3,4	0,7
tOp mean(°C	21,3	21,0	21,0	21,0	21,0	21,2	21,5	22,4	22,4	21,4	21,0	21,0	21,0
AirChange(/	1,9	1,4	1,4	1,4	1,4	1,4	1,9	3,6	4,2	2,0	1,4	1,4	1,4
Rel. Moistur	43,0	29,6	29,7	27,3	36,5	45,3	55,1	60,4	58,3	55,7	49,9	36,3	31,6
Co2(ppm)	520,0	530,3	529,9	529,8	530,9	526,9	509,2	489,6	488,5	516,9	529,5	528,8	529,5
PAQ(-)	0,4	0,6	0,6	0,6	0,5	0,4	0,2	0,1	0,1	0,2	0,3	0,5	0,6
Hours > 21	2388	0	1	1	83	258	397	647	641	325	35	0	0
Hours > 26	35	0	0	0	0	0	0	18	13	4	0	0	0
Hours > 27	6	0	0	0	0	0	0	3	3	0	0	0	0
Hours < 20	1	0	0	0	0	0	0	0	0	1	0	0	0
FanPow	861,74	70,36	63,55	70,36	68,09	70,36	71,46	84,83	84,10	69,79	70,36	68,09	70,36
HtRec	4906,29	728,40	663,46	774,74	446,23	265,58	149,02	36,70	33,50	134,00	364,61	596,72	713,34
ClRec	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
HtCoil	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
ClCoil	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Humidif	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
FloorHeat	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
FloorCool	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
CentHeatPu	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
CentCooling	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
CentHeatPu	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
CentCooling	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00

Ill. 215: Values from bsim pr month for in the patient unit orientated south

2014 | Month | Hours | Relatives Room

Relatives R	Sum/Mean	1 (31 days)	2 (28 days)	3 (31 days)	4 (30 days)	5 (31 days)	6 (30 days)	7 (31 days)	8 (31 days)	9 (30 days)	10 (31 days)	11 (30 days)	12 (31 days)
qHeating	1414,93	241,52	207,55	223,06	115,23	32,19	12,48	0,00	0,00	22,05	114,93	198,87	247,04
qCooling	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qInfiltration	-298,61	-39,58	-36,09	-42,23	-26,26	-18,54	-13,40	-9,00	-8,77	-12,37	-21,11	-32,41	-38,84
qVenting	-0,31	0,00	0,00	0,00	0,00	0,00	-0,31	0,00	0,00	0,00	0,00	0,00	0,00
qSunRad	436,71	14,17	24,38	43,72	53,20	57,63	51,48	42,90	39,57	43,51	35,34	18,75	12,04
qPeople	1058,50	89,90	81,20	89,90	87,00	89,90	87,00	89,90	89,90	87,00	89,90	87,00	89,90
qEquipment	454,43	38,60	34,86	38,60	37,35	38,60	37,35	38,60	38,60	37,35	38,60	37,35	38,60
qLighting	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qTransmissi	-1512,72	-191,96	-174,38	-200,92	-119,80	-91,06	-72,09	-51,76	-51,08	-67,61	-115,54	-171,53	-205,00
qMixing	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qVentilation	-1552,83	-152,63	-137,52	-152,12	-146,73	-108,72	-102,52	-110,64	-108,21	-109,92	-142,11	-138,01	-143,71
Sum	0,10	0,02	0,01	0,00	0,00	0,00	0,00	-0,00	0,00	0,00	0,02	0,02	0,02
tOutdoor me	8,1	0,7	0,4	-0,7	7,1	11,5	14,2	17,8	17,9	14,5	9,8	3,4	0,7
tOp mean(°C	21,4	21,0	21,0	21,0	21,0	21,2	21,6	22,7	22,7	21,4	21,0	21,0	21,0
AirChange(/	1,8	1,7	1,7	1,7	1,7	1,7	1,8	2,1	2,1	1,7	1,7	1,7	1,7
Rel. Moistur	42,2	28,9	29,1	26,7	35,7	44,8	54,5	59,3	57,4	55,0	48,7	35,4	30,9
Co2(ppm)	533,8	538,5	538,1	538,0	539,2	535,8	529,9	518,0	519,2	536,8	537,8	537,0	537,7
PAQ(-)	0,4	0,6	0,6	0,6	0,5	0,4	0,2	0,1	0,1	0,2	0,4	0,5	0,6
Hours > 21	2480	0	2	0	57	261	412	679	674	357	38	0	0
Hours > 26	40	0	0	0	0	0	0	22	15	3	0	0	0
Hours > 27	10	0	0	0	0	0	0	6	4	0	0	0	0
Hours < 20	0	0	0	0	0	0	0	0	0	0	0	0	0
FanPow	656,12	52,88	47,76	52,88	51,17	52,88	55,13	67,00	66,95	52,56	52,88	51,17	52,88
HtRec	2993,10	457,67	419,09	500,22	252,55	167,80	94,91	22,61	20,76	69,48	174,71	358,80	454,51
ClRec	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
HtCoil	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
ClCoil	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Humidif	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
FloorHeat	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
FloorCool	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
CentHeatPu	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
CentCooling	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
CentHeatPu	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
CentCooling	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00

Ill. 216: Values from bsim pr month for the relatives room orientated south

2014 | Month | Hours | Bathroom

Bathroom	Sum/Mean	1 (31 days)	2 (28 days)	3 (31 days)	4 (30 days)	5 (31 days)	6 (30 days)	7 (31 days)	8 (31 days)	9 (30 days)	10 (31 days)	11 (30 days)	12 (31 days)
qHeating	242,87	39,20	33,99	36,18	18,68	1,40	0,00	0,00	0,00	4,60	25,43	37,83	45,56
qCooling	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qInfiltration	-88,17	-11,67	-10,64	-12,45	-7,74	-5,54	-3,97	-2,58	-2,50	-3,65	-6,29	-9,62	-11,52
qVenting	-8,35	0,00	0,00	0,00	0,00	0,00	-0,88	-3,43	-3,76	-0,29	0,00	0,00	0,00
qSunRad	61,58	1,42	2,75	5,72	7,64	9,14	8,53	7,55	6,38	5,67	3,82	1,80	1,17
qPeople	438,00	37,20	33,60	37,20	36,00	37,20	36,00	37,20	37,20	36,00	37,20	36,00	37,20
qEquipment	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qLighting	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qTransmissi	-231,71	-24,91	-22,53	-25,54	-14,78	-15,30	-13,65	-10,64	-10,39	-13,30	-20,65	-27,60	-32,43
qMixing	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qVentilation	-415,11	-41,24	-37,17	-41,12	-39,79	-26,90	-26,11	-28,41	-27,45	-29,03	-39,51	-38,40	-39,97
Sum	-0,89	0,00	-0,00	-0,00	-0,00	-0,00	-0,08	-0,30	-0,50	-0,01	0,00	-0,00	0,00
tOutdoor me	8,1	0,7	0,4	-0,7	7,1	11,5	14,2	17,8	17,9	14,5	9,8	3,4	0,7
tOp mean(°C	21,3	21,0	21,0	21,0	21,0	21,3	21,6	22,5	22,4	21,3	21,0	21,0	21,0
AirChange(/	1,8	1,5	1,5	1,5	1,5	1,5	1,9	2,8	3,0	1,7	1,5	1,5	1,5
Rel. Moistur	44,3	31,5	31,6	29,3	37,9	46,8	56,3	61,0	59,1	56,8	50,4	37,5	33,2
Co2(ppm)	627,7	635,5	634,9	634,8	636,6	634,1	618,9	608,7	603,1	624,4	634,3	633,1	634,2
PAQ(-)	0,4	0,6	0,6	0,6	0,5	0,3	0,2	0,1	0,1	0,2	0,3	0,5	0,5
Hours > 21	2310	0	0	0	43	239	373	704	675	276	0	0	0
Hours > 26	32	0	0	0	0	0	0	17	12	3	0	0	0
Hours > 27	5	0	0	0	0	0	0	4	1	0	0	0	0
Hours < 20	0	0	0	0	0	0	0	0	0	0	0	0	0
FanPow	176,16	14,37	12,98	14,37	13,90	14,37	14,64	17,43	17,23	14,23	14,37	13,90	14,37
HtRec	818,44	124,36	113,87	135,92	68,62	49,28	27,53	5,53	5,12	19,76	47,47	97,49	123,50
ClRec	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
HtCoil	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
ClCoil	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Humidif	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
FloorHeat	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
FloorCool	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
CentHeatPu	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
CentCooling	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
CentHeatPu	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
CentCooling	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00

Ill. 217: Values from bsim pr month for the bathroom orientated west

2014 | Month | Hours | Patient Room

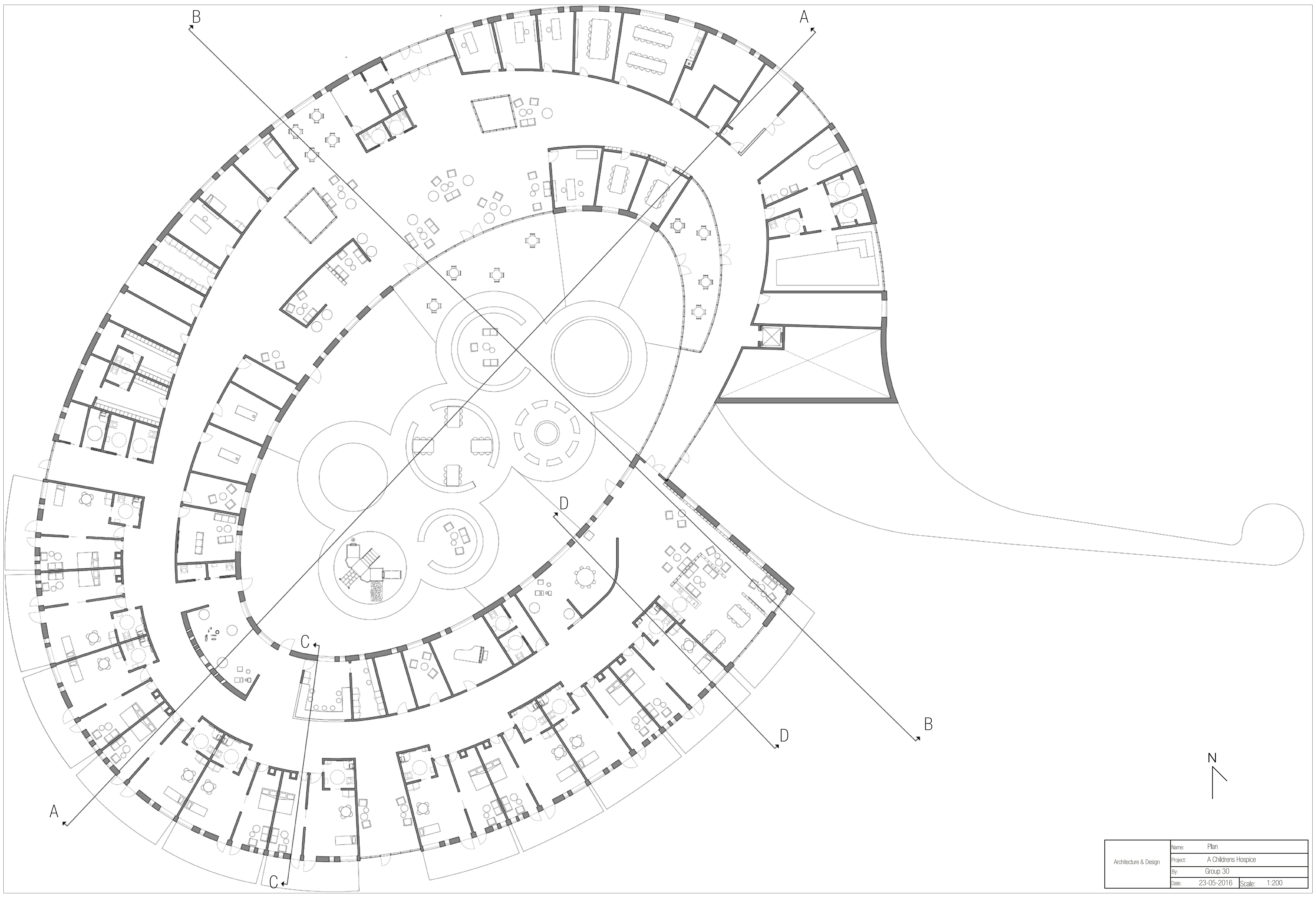
Patient Roo	Sum/Mean	1 (31 days)	2 (28 days)	3 (31 days)	4 (30 days)	5 (31 days)	6 (30 days)	7 (31 days)	8 (31 days)	9 (30 days)	10 (31 days)	11 (30 days)	12 (31 days)
qHeating	1720,20	330,90	283,32	303,40	98,73	22,69	7,61	0,00	0,00	6,37	76,33	248,94	341,92
qCooling	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qInfiltration	-473,56	-63,14	-57,57	-67,35	-41,90	-29,41	-21,03	-13,35	-12,92	-19,42	-33,85	-51,74	-61,89
qVenting	-101,76	0,00	0,00	0,00	0,00	0,00	-12,33	-43,39	-43,46	-2,58	0,00	0,00	0,00
qSunRad	802,41	17,61	35,27	76,78	102,78	117,76	107,47	94,83	83,31	78,79	51,08	22,53	14,21
qPeople	1363,27	115,79	104,58	115,79	112,05	115,79	112,05	115,79	115,79	112,05	115,79	112,05	115,79
qEquipment	454,43	38,60	34,86	38,60	37,35	38,60	37,35	38,60	38,60	37,35	38,60	37,35	38,60
qLighting	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qTransmissio	-2666,56	-352,91	-320,95	-371,12	-223,69	-160,77	-120,32	-71,01	-66,51	-113,48	-198,40	-303,12	-364,28
qMixing	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qVentilation	-1102,40	-86,83	-79,50	-96,07	-85,26	-104,63	-111,31	-122,59	-117,15	-99,19	-49,53	-66,01	-84,34
Sum	-3,97	0,00	0,01	0,03	0,05	0,01	-0,51	-1,14	-2,35	-0,10	0,02	0,00	0,00
tOutdoor me	8,1	0,7	0,4	-0,7	7,1	11,5	14,2	17,8	17,9	14,5	9,8	3,4	0,7
tOp mean(°C	21,3	21,0	21,0	21,0	21,0	21,2	21,6	22,5	22,4	21,3	21,0	21,0	21,0
AirChange(/	1,9	1,4	1,4	1,4	1,4	1,4	1,8	3,8	4,5	1,9	1,4	1,4	1,4
Rel. Moistur	43,0	29,6	29,7	27,3	36,6	45,2	54,9	60,2	58,3	55,9	50,0	36,3	31,6
Co2(ppm)	519,9	530,3	529,9	529,8	530,9	527,1	509,0	487,4	490,0	516,5	529,5	528,8	529,5
PAQ(-)	0,4	0,6	0,6	0,6	0,5	0,4	0,2	0,1	0,1	0,2	0,3	0,5	0,6
Hours > 21	2338	0	0	1	64	266	397	657	650	298	5	0	0
Hours > 26	39	0	0	0	0	0	0	21	14	4	0	0	0
Hours > 27	8	0	0	0	0	0	0	5	3	0	0	0	0
Hours < 20	1	0	0	0	0	0	0	0	0	1	0	0	0
FanPow	864,07	70,36	63,55	70,36	68,09	70,36	72,26	85,75	84,73	69,77	70,36	68,09	70,36
HtRec	4916,01	728,46	663,98	774,88	448,75	262,45	145,93	34,52	32,24	135,95	377,07	598,23	713,56
ClRec	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
HtCoil	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
ClCoil	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Humidif	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
FloorHeat	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
FloorCool	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
CentHeatPu	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
CentCooling	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
CentHeatPu	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
CentCooling	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00

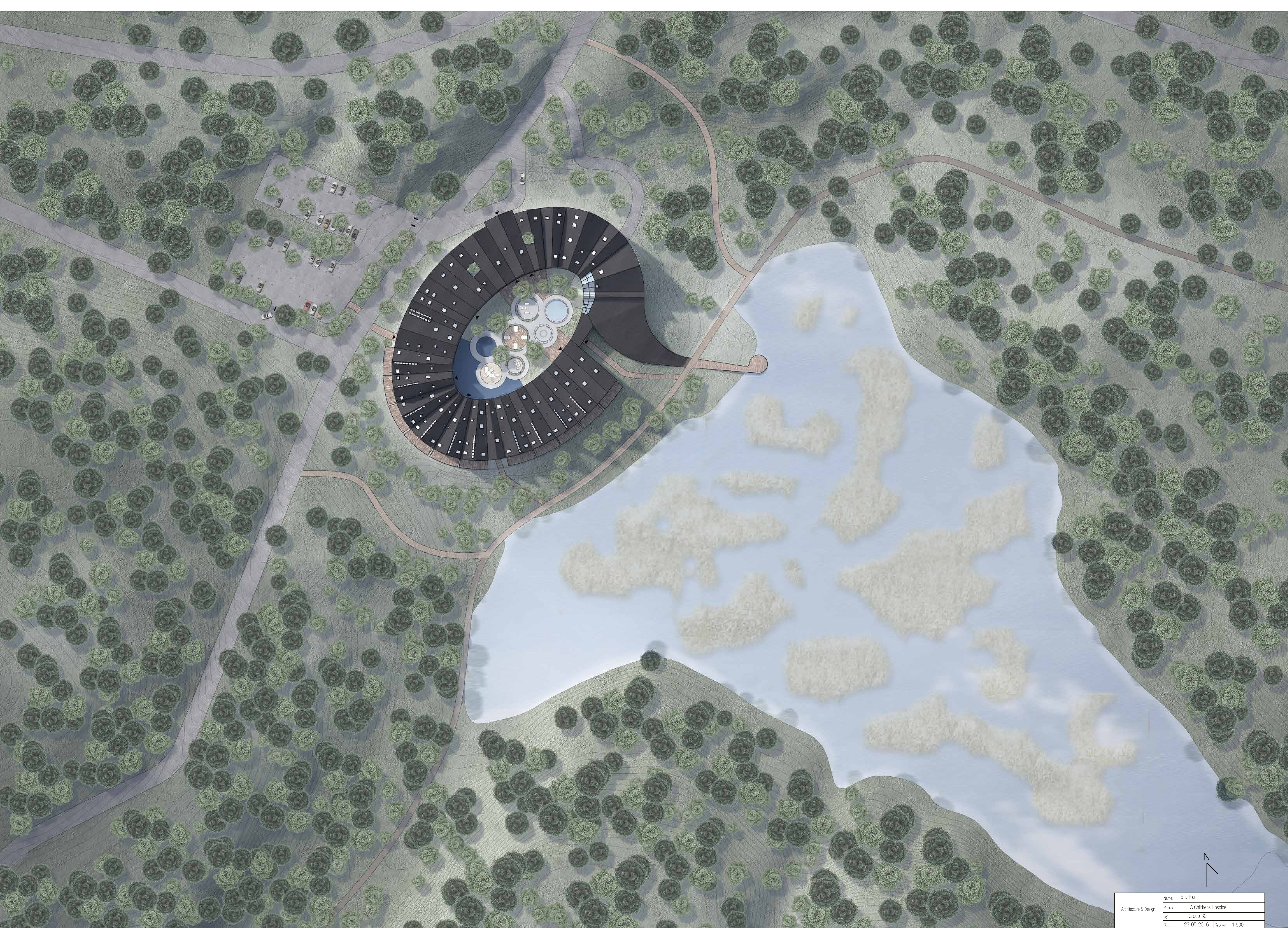
Ill. 218: Values from bsim pr month for the patient room orientated west

2014 | Month | Hours | Relatives room

Relatives roo	Sum/Mean	1 (31 days)	2 (28 days)	3 (31 days)	4 (30 days)	5 (31 days)	6 (30 days)	7 (31 days)	8 (31 days)	9 (30 days)	10 (31 days)	11 (30 days)	12 (31 days)
qHeating	1485,28	248,47	216,76	234,91	124,24	31,32	12,12	0,00	0,00	25,92	129,82	208,39	253,33
qCooling	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qInfiltration	-298,48	-39,59	-36,10	-42,24	-26,25	-18,52	-13,40	-9,05	-8,69	-12,24	-21,13	-32,43	-38,85
qVenting	-0,51	0,00	0,00	0,00	0,00	0,00	-0,51	0,00	0,00	0,00	0,00	0,00	0,00
qSunRad	375,81	7,84	16,49	35,21	47,52	57,22	52,51	46,53	38,00	35,14	22,99	10,11	6,25
qPeople	1058,50	89,90	81,20	89,90	87,00	89,90	87,00	89,90	89,90	87,00	89,90	87,00	89,90
qEquipment	454,43	38,60	34,86	38,60	37,35	38,60	37,35	38,60	38,60	37,35	38,60	37,35	38,60
qLighting	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qTransmissio	-1528,83	-192,54	-175,62	-204,16	-123,17	-91,89	-72,72	-53,18	-51,45	-68,70	-117,71	-172,22	-205,47
qMixing	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qVentilation	-1546,15	-152,68	-137,58	-152,21	-146,68	-106,61	-102,34	-112,79	-106,35	-104,47	-142,46	-138,20	-143,75
Sum	0,04	0,00	0,00	-0,00	0,01	0,02	0,01	0,00	0,00	0,00	-0,00	0,00	0,00
tOutdoor me	8,1	0,7	0,4	-0,7	7,1	11,5	14,2	17,8	17,9	14,5	9,8	3,4	0,7
tOp mean(°C	21,4	21,0	21,0	21,0	21,0	21,2	21,6	22,7	22,6	21,3	21,0	21,0	21,0
AirChange(/	1,8	1,7	1,7	1,7	1,7	1,7	1,8	2,1	2,1	1,7	1,7	1,7	1,7
Rel. Moistur	42,2	28,9	29,1	26,7	35,7	44,8	54,5	59,2	57,6	55,3	48,6	35,4	30,9
Co2(ppm)	533,9	538,5	538,1	538,0	539,2	536,0	529,5	517,7	520,0	537,1	537,8	537,0	537,7
PAQ(-)	0,4	0,6	0,6	0,6	0,5	0,4	0,2	0,1	0,1	0,2	0,4	0,5	0,6
Hours > 21	2331	0	0	0	31	249	402	688	669	290	2	0	0
Hours > 26	40	0	0	0	0	0	0	23	15	2	0	0	0
Hours > 27	9	0	0	0	0	0	0	5	4	0	0	0	0
Hours < 20	0	0	0	0	0	0	0	0	0	0	0	0	0
FanPow	655,46	52,88	47,76	52,88	51,17	52,88	55,16	67,11	66,32	52,39	52,88	51,17	52,88
HtRec	2998,20	457,67	419,09	500,22	252,55	169,66	95,31	21,84	20,98	72,85	174,71	358,80	454,51
ClRec	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
HtCoil	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
ClCoil	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Humidif	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
FloorHeat	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
FloorCool	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
CentHeatPu	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
CentCooling	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
CentHeatPu	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
CentCooling	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00

Ill. 218: Values from bsim pr month for the relatives room orientated west


B
A
D
C
D
B
A
C
N
Architecture & Design
Name: Plan
Project: A Childrens Hospice
By: Group 30
Date: 23-05-2016
Scale: 1:200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Architecture & Design
Name: Site Plan
Project: A Childrens Hospice
By: Group 30
Date: 23-05-2016
Scale: 1:500

Architecture & Design	Name:	Section A	
	Project:	A Childrens Hospice	
	By:	Group 30	
	Date:	23-05-2016	Scale: 1:200

Architecture & Design	Name:	Section B	
	Project:	A Childrens Hospice	
	By:	Group 30	
	Date:	23-05-2016	Scale: 1:200

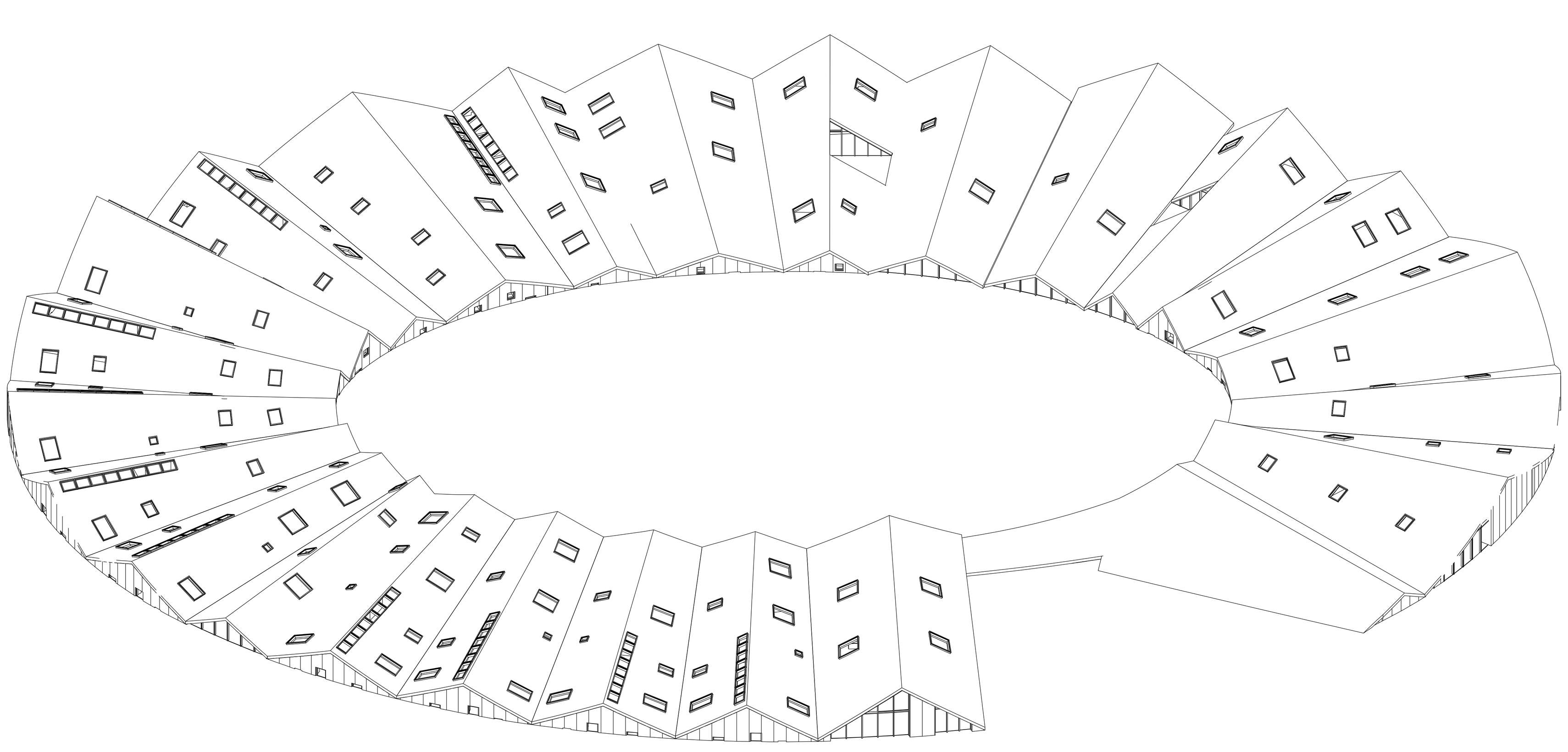
Elevation North

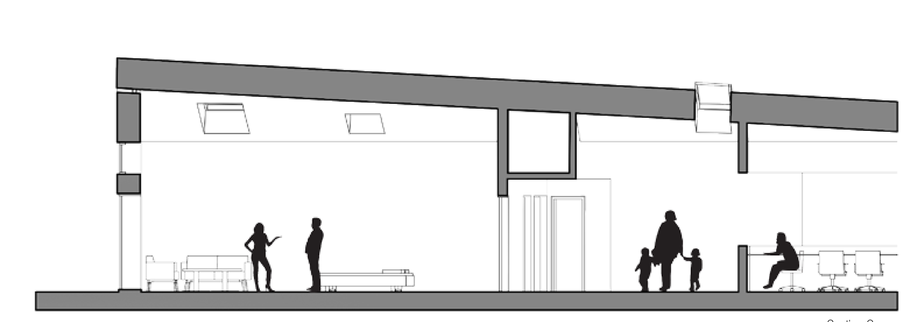
Elevation East

Elevation South

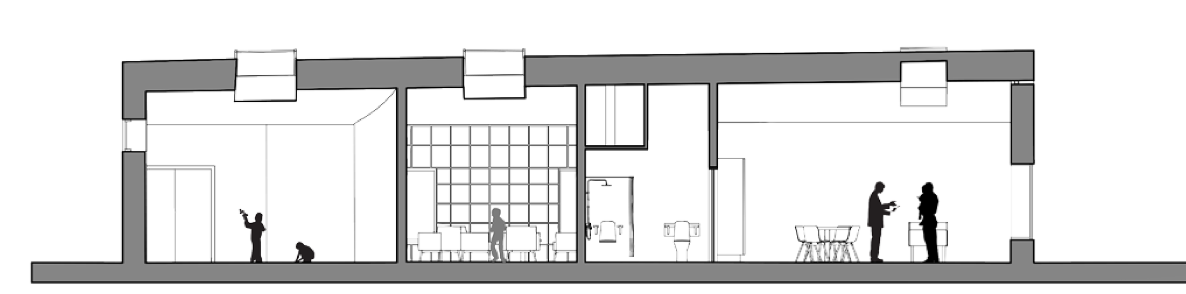
Elevation West

Architecture & Design	Name:	Elevations North, East, South and West	
	Project:	A Childrens Hospice	
	By:	Group 30	
	Date:	23-05-2016	Scale: 1:200





Section C



Section D

Architecture & Design	Name:	Section C & D	
	Project:	A Childrens Hospice	
	By:	Group 30	
	Date:	23-05-2016	Scale: 1:200